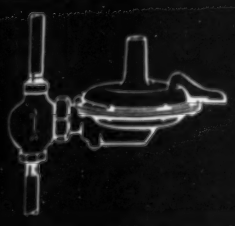
GAS

Report of GAS facsimile demonstration

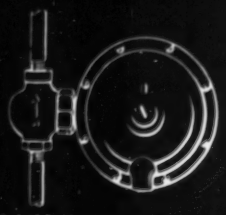
See page 107

ENGINEERING • UTILIZATION • PIPELINES • MANAGEMENT

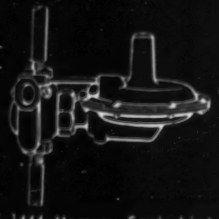


ERIES 1401 Inverted Vent—prevents collec-on of foreign material . . . screened.

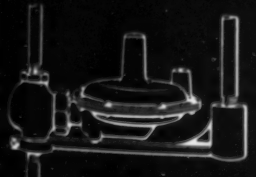
ERIES 1402 Vertical Diaphragm—Vertical ent—large area screened vent prevents llection of water or foreign material on iaphragm.



RIES 1403 Horizontal Vent



RIES 1444 Mercury Seal—highest safety ecause of location on regulator head. One nt for diaphragm chamber and seal.



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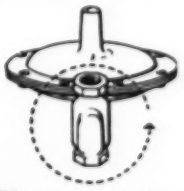
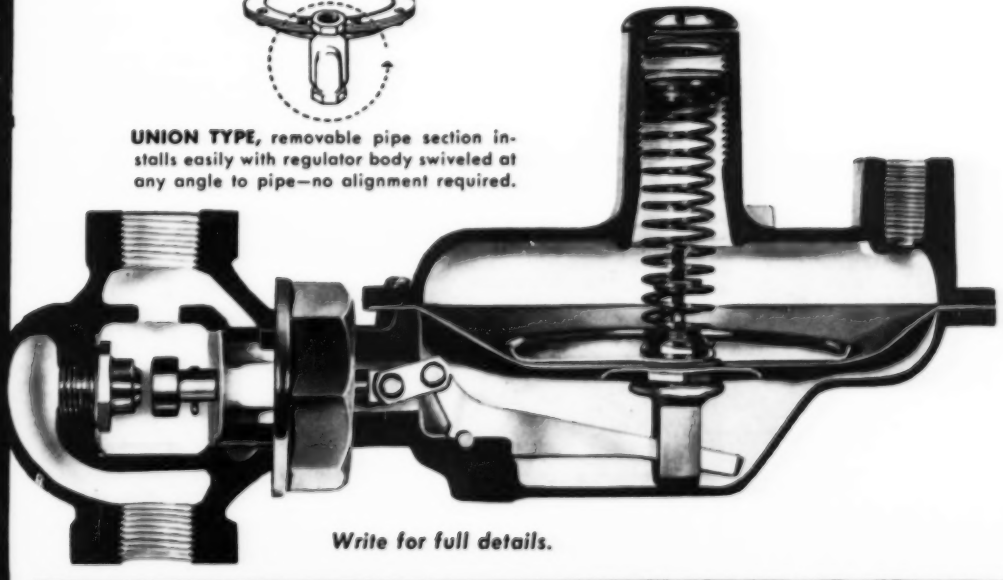


UNION TYPE, removable pipe section installs easily with regulator body swiveled at any angle to pipe—no alignment required.



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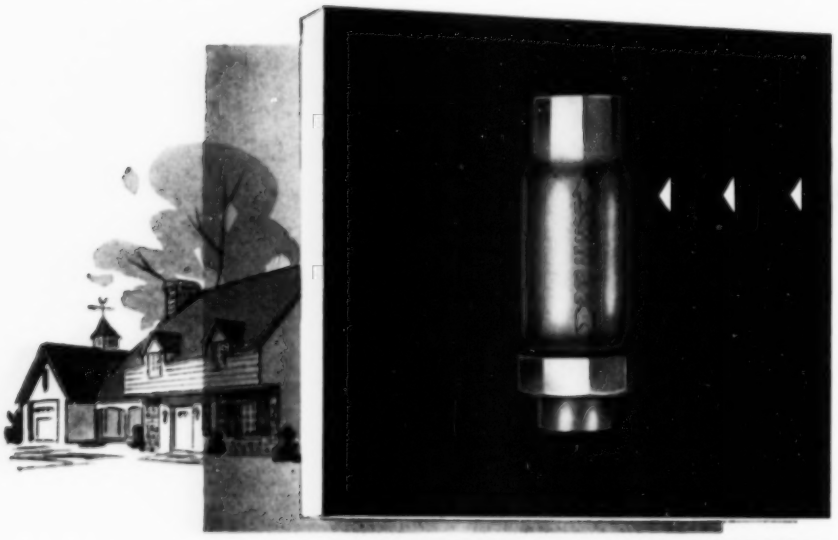
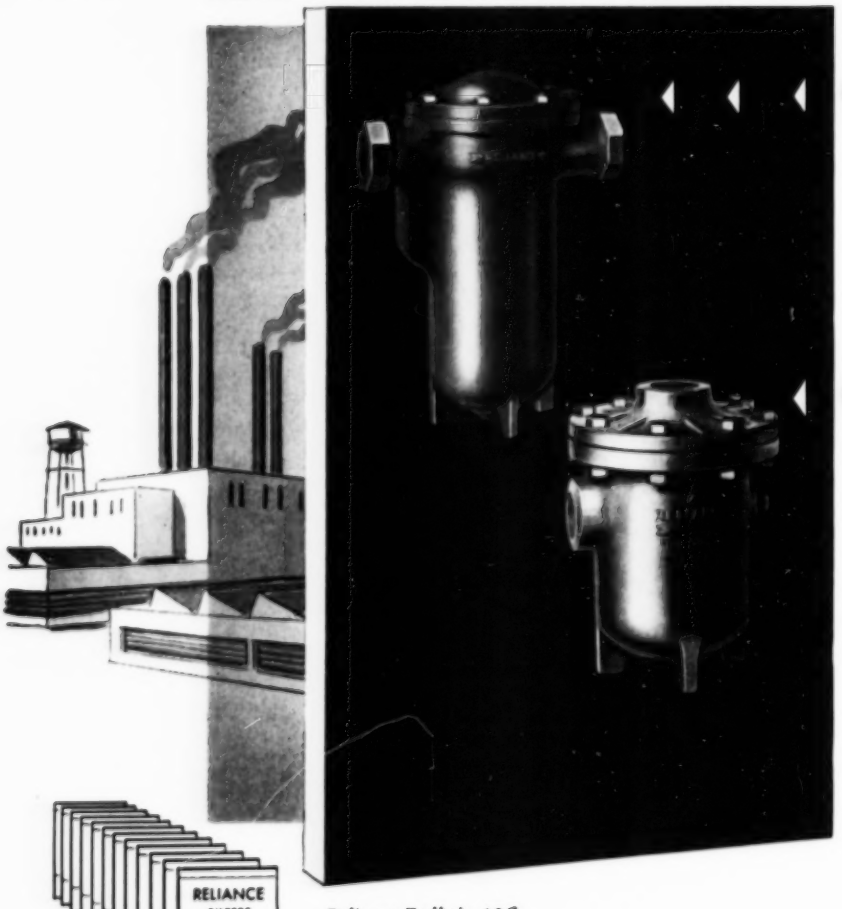


Here are three types of Reliance Filters to protect meters, regulators and gas appliances from impurities such as dust, dirt and scale.

TYPE "B" FILTER

This filter is used extensively with individual appliances such as water heaters, ranges, furnaces, etc., and is recommended for general use on house service lines in dust areas of the distribution system. It will protect the regulator, meter and house piping from dust, dirt, scale, etc. that prove so expensive in operation and maintenance. It is made with ¾" or 1" standard pipe connections. Replacement of filter elements, when necessary, can be made on the job. Filter may be in a horizontal or vertical position.



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This high capacity filter is recommended for use on distribution and industrial services where larger volumes occur. The screwed type connections and the Series 15 flanged connections are suggested for working pressures up to 150 p.s.i. The Series 30 flanged unit is used for working pressures up to 300 p.s.i.

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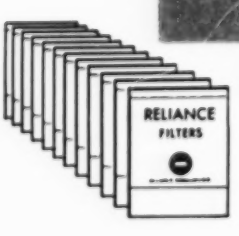

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1

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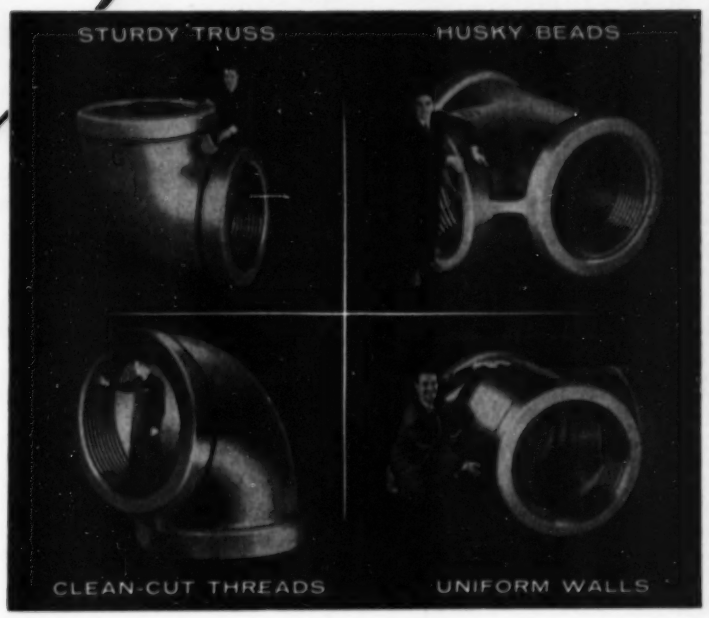
2 Grabler Mechanical advantages



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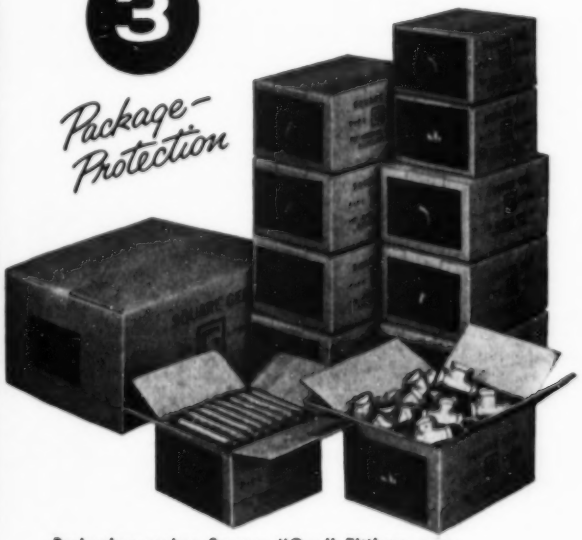
3 Package-Protection



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GAS

31ST YEAR OF PUBLICATION

IN THIS ISSUE . . . .

One of the outstanding engineering events of the year was the facsimile demonstration held last month—sponsored by GAS magazine in cooperation with Motorola, NEA, and Texas Illinois Natural Gas Pipeline Co. The dramatic manner in which the dependability of microwave for carrying electronic reproductions of pipeline records, letters, photos and graphs was confirmed is told on pages 107-120.

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BPA

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GAS Thermally Thinking

Atlantic City? Not again!

Gas appliance manufacturers, according to a GAMA announcement of a couple months ago, have once again turned thumbs down on Atlantic City for 1956. But not so AGA. We're wondering why.

The Atlantic City convention-exposition, with AGA holding the convention and GAMA showing off its wares, was decimated in 1954 by a decision of the manufacturers. As everyone who has been in the gas industry for as much as three years knows, the joint affair was a real tradition, having been held biennially from 1936 through 1952. This, we were told, was why the AGA convention reverted to the Atlantic beachtown every even-numbered year. Here was *the* place that was geared to handle the crowd *and* the exhibition. We always accepted the latter half of this argument without question, although there were times when the temptation was rather strong to tape-measure a few other exhibition halls, just to see.

Anyway, as of 1954 the question of the validity of the argument was no longer of any importance. GAMAns, many of whom had grumbled for years because of the cost of the venture, particularly when stacked up against results, voted to pull out their show. AGA, long since committed, went ahead bravely, holding an exhibition-less convention in the great windy, shell-like hulk that is Atlantic City out of season.

Now GAMA has voted against the 1956 show. Is there any reason to believe the manufacturer-members will change their minds in 1958? Or 1960? Meantime, AGA is committed for 1956 (and for 1957, in St. Louis) but no decision has been made for succeeding years. So as of today, the decks are clear for 1958.

Question: Should AGA stay with Atlantic City on the slim chance that two years from now GAMA will take a poll and find that the pendulum has swung the other way? Convention reservations must always be made a couple of years in advance, so either the manufacturers will have to anticipate their decision quite a bit more or AGA must continue to string along with Atlantic City—just in case.

It may be, of course, that the majority of members do not share our aversion to the Jersey resort. It's not that we have anything against it, really; we can stand the overblown prices, if need be. and the wind off the ocean in October is not *too* uncomfortable. The personal angle is of no consequence. But the doubt keeps creeping in that AGA members in good standing from Kansas, Oklahoma, Iowa, or Louisiana are very eager to make the long trip *every other year.*

If, according to the rules, we must pick a coast city every so often, let's spread it around. Now take Palm Beach, for example; that's awfully handy for Miami members. Or New Orleans. Or Seattle Or Skowhegan, Maine.

No matter what might be decided, it looks like it's about time AGA took its own poll.

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highlights

GAS — SPOT NEWS, TRENDS, COMMENT ON GAS INDUSTRY AFFAIRS

Trans-Canada signs contract to sell gas to TGT

That Trans-Canada and Tennessee Gas are seriously considering a gas trade at two border points, as was predicted recently, has been substantiated by the completion of an agreement between the two principals. The Canadians agreed to deliver 200 MMcf per day to TGT at the border near Emerson, Man., with an option to sell an additional 200 MMcf on an "if-and-when" basis. TGT would build a line from Emerson to hook into its present system in Tennessee; would, in turn, sell up to 90 MMcf per day, on a short-term arrangement, at the Niagara Falls boundary. Upon completion of the Trans-Canada line from Manitoba on to its eastern terminus, TGT would take surplus gas, off-peak, in the East.

Seattle begins its pipe-laying operations

Nine miles of transmission mains are now being laid to carry natural gas (when it arrives) to West Seattle (Wash.) and the downtown industrial areas. A key water crossing has been made, and engineering for three more construction jobs is being completed for contracting in December. Seattle Gas, which will merge with Washington Gas & Electric, Tacoma, to become Washington Natural Gas Co. Nov. 1, will have three city gate locations.

L.A. cranks up its hospitality machine for AGA convention

A trip to Disneyland is likely to be the high point, entertainment-wise, when the AGA delegates convene in Los Angeles Oct. 17-19; but it will vie for attention with a full program of outstanding speakers and events. J. Ed Warren, ex-PAD official and oilman, will talk on energy needs and supplies; future buying habits will be explored by another speaker; Emmett Leahy, chairman of a Hoover Task Force, will speak on paperwork management; Guy Corfield will report on "Operation Cue," the atomic test in which gas participated.

Westcoast hearings will reconvene this month

The omnibus case involving a fistful of western gas companies will go back into hearings with every phase of negotiations still in a highlyspeculative position. The only aspect of the plans that appears certain to win approval is the importation of gas from Canada. But El Paso Natural and PG&E remain at loggerheads over where gas from the former would be delivered to the latter. An eventful result for Californians may well be less gas than they want at higher prices than they want to pay.

Fulbright bill marks time

Since the Harris bill to give producers more freedom in contracting to sell their gas has passed the house—even though by a squeaky margin—those who profess to fathom Senate thinking are confident its counterpart, the Fulbright bill, will get through next session. Meanwhile, FPC is expected to continue going easy in administration of the Natural Gas Act as it affects producers pending the outcome—although delaying actions are no doubt politically perilous at the moment in view of "probe" activities by Congress into the commission and other politically "hot" agencies.

Tripling of Herscher storage sendout okayed

Permissible maximum day withdrawals from Herscher Dome in Kankakee county, Ill. have been raised by the FPC from 150 MMcf to 430. Natural Gas Storage Co. of Iillinois, operator of the field, was also authorized to construct an additional tie-in to Texas Illinois Natural Gas Pipeline Co.'s facilities and to make compressor station changes as required to re-inject gas now being vented. Natural Gas Pipeline Co. of Illinois was also granted permission to construct a side tap and build five lateral loops to carry gas to existing utility customers in Iowa and Illinois.

TGT construction starts Sept. 1

Work on the big 370-mile 30-in. line that Tennessee Gas Transmission Co. has planned to build from Agua Dulce, Texas, to Kinder, La., is ready to start. Contracts have been let. Completion is expected by Nov. 1.

*regulatory and legislative trends

Hoover studies may lead to improved administrative procedures

UNDER the bright searchlights of President Eisenhower's recent Conference on Administrative Procedure, and the Hoover Commission Report to Congress, the defects in federal administrative procedure have been exposed; and corrective action will be forced by the will of the electorate. A majority of our citizens and all utilities that engage in interstate commerce will benefit from the expected greater equality, efficiency and economy of administrative justice.

In speaking about the recommended methods of reducing delay, expense and volume of records in certain administrative proceedings, President Eisenhower said, "Federal administrative procedures should be and can be steadily improved."

The first federal regulatory commission of importance was established to regulate the railroads in 1887. In the 68 years since the origin of the Interstate Commerce Commission, the authority of regulatory agencies has been extended to cover much of America's economic life. Federal administrative agencies now regulate gas, electric, telegraph and telephone utilities; fair trade, banking, atomic energy, airlines, radio, television, motor transportation, securities, labor relations and numerous other subjects.

The powers that are entrusted to these regulating agencies, and which they need to perform their essential functions, present opportunities for oppression and wrong. The extent of their powers over the citizen must be determined, while the rights of the citizen against them must be clarified. A system of administrative law is being developed to safeguard the citizen. The present plan to improve administrative procedure will make fair play the fundamental rule, and will give the citizen more efficient government service for his tax dollar.

The President's conference gives us hope

The President's Conference on Administrative Procedure was composed of 75 members and delegates. They represented 57 departments of the federal government that have adjudicatory and rule making functions. They also represented members of the judiciary, federal trial examiners, and practicing lawyers.

The most important recommendations were designed to reduce delay, expense and unnecessarily voluminous records in administrative proceedings, as well as to improve the quality of hearing examiners.

First, the conference recommended the establishment of an Office of Administrative Procedure to pursue continuous studies for the improvement of federal administrative procedures. The office is not intended to dictate to the administrative agencies, but rather to make constructive suggestions.

It was recommended that the United States courts be urged to encourage hearing officers and agencies to exclude the irrelevant, immaterial, incompetent, and repetitious evidence. The current tendency on the part of hearing officers to excessive leniencies has been caused by the attitude of the regulatory agencies, and of the federal courts, which have criticized them for excluding evidence of doubtful relevancy. The result has been excessive delay and expense, and unduly voluminous records. Effective remedy requires the reversal of the present attitude of hearing officers.

Another recommendation was the centralization of all of the work and responsibility in connection with the hearing examiner program within a single new bureau of the Civil Service Commission. The new bureau would be composed of two lawyers experienced in federal administrative adjudication, and at least two of the five officials would have a comprehensive view of the hearing examiner program. The present qualification standards for hearing officers are high, and would be maintained or raised. The Civil Service Commission would continue recruiting hearing examiners on an open competitive basis, and would concentrate on the most likely source of qualified applicants, such as lawyers with trial experience in administrative law both in and out of government service. The Civil Service Commission would maintain the career-merit system. A recommended top salary for a hearing officer having the greatest responsibility was $11,800.

The General Services Administration would assist the agencies to secure transcripts of administrative proceedings at the lowest possible cost.

The conference recommended to the executive agencies that they consider unnecessary delay, expense and volume of records to be detrimental to the public interest. This recommendation is in terms of the public interest, not the interest of parties either governmental or private. It presents a reversal of a growing attitude toward these long proceedings. It emphasizes the public importance of efficiency in the administrative process. Many procedural consequences flow from this basic concept.

It was also recommended that the

*A monthly commentary on national and state developments by an expert in the field of utility law.

Regulatory trends... Prehearing conferences suggested to simplify, clarify and dispose of issues

agencies study the performance of hearing examiners and initiate removal proceedings where it is appropriate. It is thought that there may be a number of hearing examiners who are not fit to hold such positions of importance and responsibility. A fair type of removal procedure is available, and should be employed to improve the quality of the examiner corps.

Another recommendation was that the agencies define the status and authority of their counsel, especially the extent to which the agency counsel may take the position of an advocate, or whether he should confine himself to the developing of relevant evidence. There have been many cases where days of hearings were consumed in the proof of subjects which were undisputed because agency counsel was not sure that he had power to make a stipulation on those facts.

The conference found that it was feasible to have uniform rules for all agencies on many aspects of administrative procedure. It was recommended that the agencies collaborate with the bar and with the Office of Administrative Procedure in the development and adoption of uniform rules on the subjects of (1) computation of time, (2) service of papers, (3) subpoenas, (4) depositions, (5) official notice of matters of law, (6) official notice of material facts, (7) stipulations in proceedings involving numerous parties, (8) form and content of initial and final decisions, (9) appeals from intermediate decisions.

A further recommendation was that the agencies require the making of the issues as precise as possible at the outset so that hearing officers may promptly conduct the hearing on relevant, competent and material evidence only.

Federal agencies are encouraged to have their hearing officers call prehearing conferences with the objective of simplification, clarification and disposition of the issues involved in the case. This automatically shortens the proof on the issues.

Another time saving recommendation is that the agencies require documentary evidence to be served on all participants in the proceeding sufficiently in advance of the acceptance of such evidence to permit preparation of cross-examination and rebuttal.

A recommendation that would save time and expense is that agencies encourage all direct opinion or expert testimony based on economic or statistical data be reduced to written sworn statements. These written statements, together with the companion exhibits, would be furnished to all participants in the proceeding a reasonable time in advance of the hearing. These sworn statements would be acceptable as evidence at the hearing, subject to valid objections.

The conference recommended that the agencies establish in-service training for agency lawyers, including systematic instruction for newly employed attorneys and practical "trial clinics" for experienced trial attorneys.

Agencies would publish for the use of practitioners manuals of an advisory nature, describing the procedural steps required in all types of proceedings conducted under each statute administered by the agency.

In this phase of improving administrative procedure, the conference added that agencies should cooperate with universities and bar associations undertaking to conduct lawyers' institutes in specialized fields of administrative law.

The Hoover Commission would reform the legal services and procedure of the executive branch

There are about 5300 attorneys in 54 departments and agencies of the executive branch, not counting the Department of Defense. In that department there are 1300 civilian attorneys and 3100 military personnel performing legal duties. Government attorneys are responsible for furnishing legal advice, drafting documents and performing other legal services at every level. The Hoover Commission stated that "efficient performance of these services is vital to the administration of governmental affairs." The Hoover Commission made its report to the Congress of the United States on April 11, 1955. This most far-reaching and significant report ever made upon this subject contains the following important recommendations:

1. Establishment of an Administrative Court of the United States consisting of three sections in the fields of taxation, trade regulation and labor relations, respectively.

2. Creation of a corps of hearing officers serving as judicial officers, with authority to conduct all administrative hearings for departments and agencies of the executive branch.

3. Enactment of an Administrative Code to replace and improve the Administrative Procedure Act of 1946.

4. Conforming procedures in the adjudication of administrative cases as closely as possible to recognized judicial practices and enlarging the scope of court review of administrative decisions.

5. Formation of a career legal service for all attorneys in the executive branch.

6. Establishment of an Office of Legal Services and Procedure in the Department of Justice to administer the career legal service and to help agencies in the clarification, simplification, and uniformity of agency rules of procedure under the Administrative Code.

7. Integration and coordination of all legal staffs of the executive branch.

8. Reorganization of the Department of Justice into two divisions—one for legal management and the other for litigation.

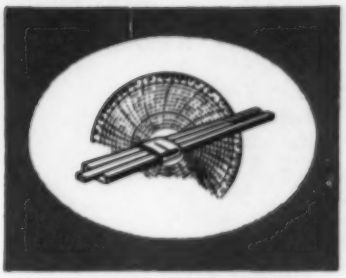
9. Establishment by statute of minimum standards of conduct for all persons appearing in a representative capacity before departments and agencies of the executive branch.

10. Forming a Federal Grievance Committee to hear complaints against attorneys for misconduct in administrative practice, and empowering United States district courts to discipline such attorneys.

11. Confining the practice of law before departments and agencies to members of the Bar and inauguration of a simple method by which an attorney in good standing may appear before any agency without further qualification.

Gas companies and individual citizens will realize dividends of equity and economy from their investments in promoting the betterment of administrative procedure. ■

technical trends



• By GUY CORFIELD

Specifications and standardization

In the procurement and operating phases of any business, and particularly a technical business, it would seem that there could be no argument against the desirability of specifications and standardization; nor that the two groups that will be most interested are the purchasing agent and his staff, and the engineers concerned with design, testing, and operation. It also appears that the most efficient results can be obtained through mutual understanding and cooperation between these two groups. While the engineers are obviously in the best position to develop and state exact specifications for composition, dimension and performance, they should agree with the purchasing agent that there are practical aspects of prompt and economic procurement, both human and commercial, which dictate (1) the necessity for an open mind toward revisions, changes and substitutions; (2) the advantage of specifying standard items as much as possible; and (3) the desirability of avoiding dependence on only one manufacturer or vendor.

With respect to (1), revisions and changes in specifications would seem essential to keep up with "advances in the art"; they might be in materials, formulas, or even in methods of test, and could come from the suppliers who should be invited to make suggestions. Substitutions might also be necessary to obtain prompt delivery. The engineers, however, should be given an opportunity to review, test if necessary, and accept the substitutions rather than discover that changes have been made without their knowledge.

As regards (2), the specification of standard items is obviously advantageous to all parties and is materially assisted by the activities of the American Standards Association and the commercial standard section of the U. S. Department of Commerce. While there is, of course, a limit to available standards, the specification, for instance, of special threads, bolt and pipe sizes, etc., is annoying and usually unnecessary.

As for (3), it is particularly desirable for ease of procurement, and to take advantage of competitive prices, to have specifications clear, complete, understandable, and generally acceptable so that competitive bidding can be done and the purchasing agent need not depend on one supplier. It may not always be possible, or the expense justified, to write a complete specification for material desired, but it may still help to ask for a name brand or equal or equivalent.

Mechanical failures of metals in service

A bulletin with that title, identified as NBS Circular 550, has recently been issued by the National Bureau of Standards and can be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. for 30 cents. It deals with failures, other than those occurring in normal service, due simply to loads greater than the strength of the parts, stating that underestimation of normal strength is uncommon with present engineering knowledge.

The three most frequent causes of failure are said to be (1) fatigue fracture, when the metal is subjected to repeated or fluctuating loads of lower stress effect than would be expected to cause static rupture; (2) brittle fracture where defects, deep scratches, etc., have the effect of reducing the cross-section so that a brittle material will crack through, often suddenly, rather than distort; and (3) stress-corrosion cracking whereby a combination of low-value stress (which may be unrelieved fabrication stress rather than applied stress) and corrosion, which also need not be severe, weaken the metal. Mention is made of a type of fatigue failure termed fretting, produced by the rubbing together of parts which are supposedly firmly bolted together; in steel structures, a warning signal is the appearance of a fine brown powder.

It is stated that the cause of a service fracture may have its origin in the design, fabrication, or use of a metal structure or machine element, and the following precautions are listed as being the most important:

"1. *Design.* Elimination of sharp reentrant angles at fillets, keyways, and other changes of section. Accurate stress analysis at points of stress concentration and verification of the analysis by experiment or by fatigue testing of sample parts. Selection of material and fabricating methods to produce parts having adequate transverse strength if significant stresses are to be applied in that direction. Proper combination of material and static design stress to eliminate the possibility of stress corrosion cracking in the environments to be encountered. Specification of materials that will provide adequate resistance to brittle fracture, particularly under shock loading and low ambient temperatures.

"2. *Fabrication.* Careful workmanship to avoid points of stress concentration due to welding defects, tool marks, improperly formed fillets, grinding cracks, quenching cracks, etc. Control of forging practice to avoid folds, seams, and internal fissures. Protective atmospheres during heat treatment to avoid decarburization. Proper control or elimination of residual stress due to press fits or cold-working in parts subject to corrosive environment. Rigid inspection of highly stressed parts to eliminate surface imperfections.

"3. *Use.* Control of operations to restrict the loads to those for which the machine or structure was designed. Protection of parts from corrosion that may be damaging. Periodic inspection of highly stressed members by personnel acquainted with the nature of fatigue failures. Prompt repair or replacement of parts damaged by unusual conditions, such as fire, collision, overloading, or unusual corrosion. Periodic disassembly of clamped members to inspect for evidence of fretting." ■

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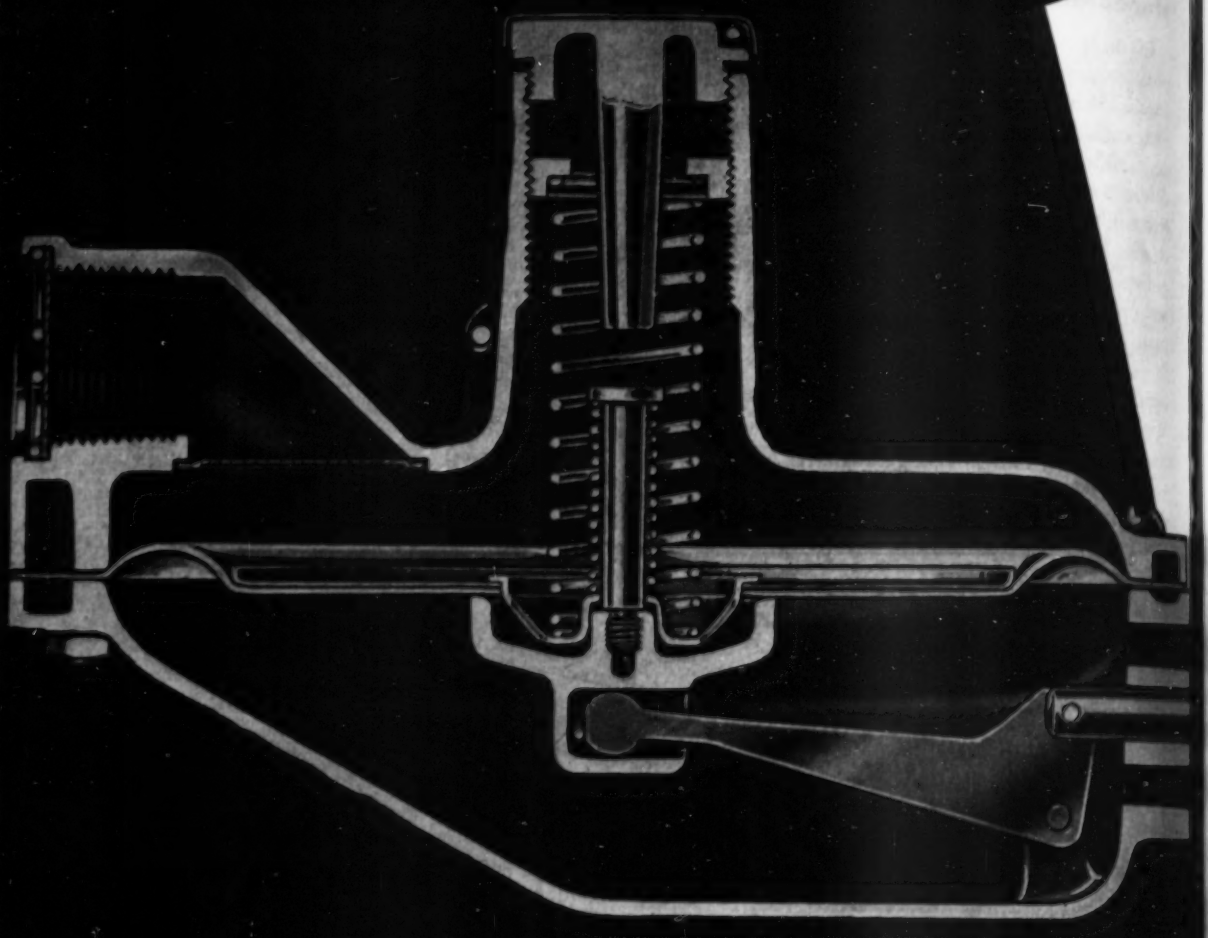

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GAS

SEPTEMBER 1955

At the New York symposium, from left: Orden, Marples, Britton, Starr, Ladwig, Hyman, Beggs, Hendrickson, Chapman, Wile, Bayer, Neisius, Trunk, Moore, Sopka, Clennon, Leary.

The fourth GAS computer symposium

THE latest symposium in the *GAS* series on electronic analogue and digital computers was held Aug. 1 at the Shelton hotel in New York City. This meeting dealt again with the application of computers in gas distribution engineering in general and, in particular, with the currently vital subject of gas piping network analysis. Originally, it had been planned to hold a single symposium beamed at distribution engineering with the aid of electronic computers, but the response and interest produced by the Chicago symposium (May 1955) on this subject dictated its choice as the subject for the New York gathering.

Those present for the roundtable were:

Howard Levin, Ebasco Services Inc., New York; A. R. Bayer, assistant engineer of development and planning, Brooklyn Union Gas Co.; S. I. Hyman, engineer's assistant, Brooklyn Union; James H. Starr, consultant and developer of the network analyzer that bears his name, LaGrange, Ill.; Charles W. Beggs, project engineer, gas department, Public Service Gas & Electric Co., Newark, N. J.; Frank W. Ladwig, manager, computer section, Burroughs Corp., Paoli, Pa.; Dr. Alex Orden, mathematical analysis director, Burroughs Corp.; Dr. J. J. Sopka, applied science representative, International Business Machines Corp., New York; E. F. Trunk, chief engineer, Laclede Gas Co., St. Louis (Mr. Trunk was also in attendance at the Chicago symposium); Frank J. Leary, computer research specialist, Remington Rand Inc., New York; John P. Clennon, senior engineer, Peoples Gas Light & Coke Co., Chicago (Mr. Clennon was also at the Chicago symposium); W. V. Neisius, vice president, Logistics Research Inc., Redondo Beach, Calif.; D. D. Britton, Logistics Research Inc.; Robert C. Moore, consulting engineer to the analyzer division, Standard Electric Time Co., Springfield, Mass. (Mr. Moore not only attended the Chicago symposium, but was on hand to sit in on the Los Angeles meeting); Robert Marples, engineer, Consolidated Edison Co. of New York; A. C. Hendrickson, Remington Rand Inc., New York. Also Peter Wile, New York district manager, and Frank Chapman, editor-manager, *GAS* magazine.

With this distinguished group participating, the volume of material that was produced was such that it would be impossible to give in a single article a full presentation of the ideas and opinions expressed. For example, the transcribed proceedings of the meeting itself involve some 46 single-spaced, type-written pages. This report is based upon the preliminary discussions of *GAS*' questions as submitted by the panel members in advance of the meeting. The roundtable discussion itself will be treated in a separate article at a later date.

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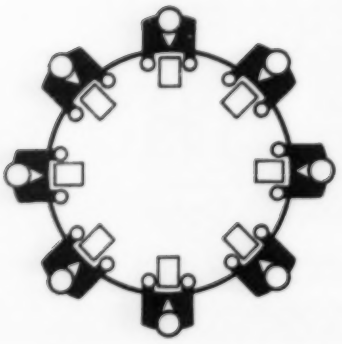


The place of computers in gas piping network analysis

By J. FRED EBDON • Managing Editor

IN DISTRIBUTION system analysis, one of the factors of first interest to gas engineers is the method for network solution. For years some companies have been using formulae and systems developed in their own engineering departments by empirical evolution while others have researched the literature and found that methods developed for other analyses have been applicable to gas system engineering. Thus, the Hardy Cross method found its way into gas network analysis and has become more universally used than any other suggested mathematical approach. Another method, developed by Jack Warga of ElectroData in Pasadena, Calif., was presented to the gas industry through distribution by GAS earlier in the year. Both of these methods have been given at least preliminary evaluation along with various modifications; therefore, at the New York symposium an effort was made to see if the panel members had formed any definite ideas as to the best method for network analysis and if more work needed to be done toward development of a more advantageous method. This question was presented to the panel:

Q After discussing network analysis methods, does it appear that one mathematical approach might become the universally preferred method? Should more work be done to develop a better method or to improve present methods?

In the conference it was agreed that in the case of the second part of the question there is a need for further work to give to the gas industry an improved method of gas piping network analysis. Considerable discussion of the applied mathematics involved was heard. Most of this discussion was technical and detailed to an extreme that makes it impractical to present it at this time.

Considerations

As always, it is practically impossible to separate the engineering considerations from the economics. James H. Starr, developer of the Starr network analyzer, a linear-type analogue machine widely used in the electric industry and used to a lesser extent in the gas industry, brought this out by saying, "Economic considerations are quite rapidly transferring all but the simplest network problems from the human to the machine computer. The 'preferred mathematical method' then becomes that most readily adaptable to the available machine. Evolution in the computer field is very rapid and the designs most promising today may not be typical tomorrow. It follows that it may well be progress in the computer development which dictated the formulation of network problems, rather than strictly mathematical considerations." Thus, the concept of the machine evolution as related to method development is introduced and will undoubtedly be considered time and again by gas engineers as research is continued into the mathematics of system analysis.

The Hardy Cross method was the focal point of much of the discussion produced by this question. Charles Beggs reported to the group that he had tried the Hardy Cross system at Public Service in Newark and found under experimentation that it offers no advantage to the operations. Also, he observed failure of the iterations to close. It is his opinion that the method can produce nothing in the way of improving the currently used method of distribution network analysis, which is done with a McIlroy non-linear analogue computer. Such methods are simply not needed when this analyzer is used.

Ed Trunk has used the Hardy Cross method, manually calculating networks, but has found its practicality limited. Mr. Trunk said, "From what I know of some of the shortcomings of the Hardy Cross method, after using it for years, I can see the reasons for the search for an improved method. This is particularly true when it is used with a digital computer. It is my feeling that a better method will be found as more use is made of digital computers. The search will be for a method giving faster and more certain convergence." At the present time Mr. Trunk's company, Laclede Gas Co., is using a McIlroy analyzer and has produced noteworthy results with it; however, in his analysis of the Hardy Cross for digital equipment he pointed out that an IBM program, for instance, could be visualized in which only the initial block of punched cards are tabulated, and read into the calculator, and the machine directed to produce the final answer on a set of cards or on a printed tab sheet.

Acknowledged conflicts

W. V. Neisius, Logistics Inc., gave an interesting discussion of this question. He acknowledged the conflict that is apparent from a review of the literature describing the Hardy Cross method. In his words, "In some instances it appears that while the mathematicians

are proving that the method will not work, the engineers are busily solving their problems by the Hardy Cross technique. Conflicts in existing literature, with regard to the number of iterations necessary, show in one case that a 150-loop problem will satisfactorily converge in eight iterations and in another case that a 150-loop problem would require a minimum of 50 iterations for satisfactory conversion. Dr. Neisius continued, "While there is no doubt that more sophisticated mathematical techniques will be developed, this is no reason for not using the Hardy Cross method at the present time." He mentioned that simplified programming techniques have been produced for use on Logistic's ALWAC with the Hardy Cross method and that the continued use of these will lead to further information that can be used for a more experienced evaluation of the method and will certainly suggest the way for improvements.

Coupled with this enlightened opinion is that of John Clennon, Peoples Gas Light & Coke Co., Chicago, who has had computer experience using a Starr Network Analyzer and has investigated other computing equipment. He selects an analytical method for gas piping networks on the basis that the method that can be understood by the gas engineer and yield the correct answer in the shortest time will be universally accepted. There are few who would disagree with this statement. At Peoples Gas, they have experienced satisfactory results when the Hardy Cross system has been used, but the comparison with other methods has been informal and on a trial-and-error basis.

Method comparison

"Any improvement which could be made would naturally be welcomed. Initially, this investigation could establish a comparison among the three methods mentioned," Mr. Clennon said. The three methods are the Hardy Cross, the modified Hardy Cross, and the Warga methods. He further suggested that an alternative would be to approach the problem from a viewpoint different from the iterative method, e.g., simultaneous equations.

A. R. Bayer, Brooklyn Union Gas Co., listed three requirements for a mathematical method of network analysis:

1. It must demand a minimum of simplifying assumptions in the conversion from the pipe network to the mathematical model.

2. The computations must be performed within a reasonable number of iterations.

3. The number of equations to be set up for each additional pipe, loop, or junction should be kept to a minimum.

In his analysis of the question, Mr. Bayer stated that, "A desirable feature would be suitability to modification for the introduction of cost data and also the determination of optimum reinforcements to an inadequate system. No formula that I now know of meets all of these requirements. I believe a modified Hardy Cross is the best now available," continued Mr. Bayer. "More work should be done to improve the mathematical techniques now available. The resulting equation should be such that the number of 'educated guesses' required of the distribution engineer may be kept to a minimum."

"Another area of needed development is that of load data," said Mr. Bayer. "The accuracy of our flow computations is limited by the accuracy of the assumed loads on the system. Computers are well adapted to the calculation of statistical data. In this area Columbia Gas System is doing much work."

More experience

Frank W. Ladwig of Burroughs summed up his feelings on the subject by replying, "Network methods such as the Hardy Cross, modifications of the Hardy Cross, the Warga method, etc., appear to be ideally suited for solution on electronic digital computers. Until we have had more experience with the application of computers to this work, the present working methods will probably continue to be the most popular."

The most important conclusion brought forth by the discussion of the first question is that there needs to be and probably will be more work done either to improve existing methods or preferably to develop new ones.

The panel members gave somewhat varied evaluations of Jack Warga's method. At least one member expressed the view that it appears that the Warga method is a pretty good answer to the problem of gas piping network analysis. Another member reported it has been his experience that the Warga method has the disadvantage that unless simplifying assumptions are made, a very large number of iterations is required.

Q **Suppose the chief engineer of a distribution company has become aware of the computer techniques that have been used for gas distribution network analysis, and has decided he would like to investigate the application of computers to his company's opertaions. How would you advise him to make this study?**

Computers, and some of the material that has been written about them, have left an impression of mystery and frustration among the gas industry's engineers who have not had the opportunity to investigate the application of these electronic tools to distribution engineering. There is always the question of how to bridge the gap between manual methods with conventional tools and modern high-speed computational techniques. The terms used by computer-wise engineers form an interesting language, but this language is likely to cast a shroud of complexity over a science that, in the highest order of the refinement of the art, is indeed as complex as you please. On the other hand, the linear and non-linear analyzers that have found use in the gas industry and the digital machines that have enjoyed similar application should not be considered too complicated to the average gas engineer and certainly their techniques have been readily understood by those who have made serious effort to grasp an understanding of them and their productivity.

Measure results

In Mr. Ladwig's answer to this question, he suggested that, "Measurement comes before improvement. Therefore, we would suggest that the chief engineer of a distribution company list the details of his present operation. It would seem wise to measure the results obtained and the cost of obtaining these results under present methods.

"One large company studying the application of computers," Mr. Ladwig continued, "estimated that it would receive greater benefits from its methods

Computers... "Use of computers for predicting system design 10 or 20 years ahead is with us now"

study made before installing a computer than from the installation of the computer itself. After a careful methods study, and a possible revision of the present system, typical sample problems could be submitted to the various computer companies. After evaluating the solutions of his problems on the various computers, the chief engineer would be in a position to decide whether to order a computer, or continue with his present methods, which have been improved as a result of his methods study. He then would want to go through the following steps in the usual time table for applying computers:

"1. Obtain management approval and backing.

"2. Train supervisory staff.

"3. Train programmer's staff—commence initial programming. (These initial programs can be checked on the manufacturer's own demonstration equipment.)

"4. Install and check out equipment and programs.

"5. Begin actual work on the computer."

Mr. Beggs recommended that the following AGA papers be digested as a first step:

1. "Gas Distribution Problems Solved by Electrical Network Calculators," DMC-51-14, April 1951, John P. Clennon and J. K. Dawson.

2. "Gas Pipe Networks Analyzed by Direct Reading Analogue Computer," DMC-52-10, April 1952, Malcolm S. McIlroy.

3. "A Punched Card Program for Calculating Gas Distribution Network Pressures by the Hardy Cross Method," DMC-55-1, April 1955, Robert D. Sickafoose.

These should give him the knowledge of the modern calculating methods using the linear analyzer, the nonlinear analyzer, and the digital computer. Mr. Beggs felt it is important to have this system comparison before proceeding to solve a problem of his own on each of the three types of computer equipment.

In the opinion of Ed Trunk, it is probably not possible to outline a procedure that would be applicable to more than one company because such a thing as rate of growth over a period of several years might be the deciding factor in the amount of computations and the type of computer equipment for one company, but it might be a much more minor factor in the case of another company. His recommended first step would be to investigate computer equipment in other departments of the company (if such equipment is in use) and try its application to system analysis. Mr. Trunk believes that the next step becomes an economic study to determine the type of computer that will give the lowest over-all cost for computational requirements. He states, "The type of basic load information available might also have an important bearing upon the type of equipment most suitable."

James H. Starr abbreviated his reply somewhat as he felt that his position as a manufacturer of a specific type of network calculator would influence his recommendation somewhat, but he stated that he would be inclined to refer the chief engineer to the engineers

Ed Trunk (left) recommended that engineers begin with a study of what other departments of the company are doing with similar equipment. His companions are Bob Moore of Standard Electric Time and Dr. J. J. Sopka of International Business Machines.

of one or more companies that have used network calculators for solving distribution problems.

Brooklyn Union's A. R. Bayer expressed this interesting opinion: "Like all engineering problems, this becomes a matter of economic analysis. The first step would be to make a realistic evaluation on the analytic requirements of his system." As an example, Mr. Bayer stated that, "A small 'mature' system requires less analysis than a larger fragmentary, rapidly expanding one. Having made this analysis, assign an engineer to read up on the techniques now in use. Then, set up a sample problem typical of the company's distribution system and solve it by manual methods. This engineer would then visit installations of each type of computer to get the feel of what is involved. At each of these installations, he would solve the sample problem. With this background he can then begin an evaluation of the applicability of computers to his company's needs."

Active investigation

(At least one major company has followed a system of computer study that closely parallels that suggested by Mr. Bayer. This company has had an engineer actively investigating computers at gas company installations, manufacturers' training schools, and independent facilities for at least a year. This program should reveal to the gas company exactly what equipment it can support on an economic basis and the extent to which it wants to subject its computational load to automation.)

"Assuming the company has a record of its mains, showing size, length, and location; accurate load data for the present, and a forecasted load for the future; and a flow formula that it will accept," John P. Clennon would advise the following: "First, establish the number and frequency of distribution problems and their complexity; next examine the manpower available for the operation of a computer and the supplying of necessary data and problems; finally, evaluate the comparison between the present methods, procuring a computer, using available computer time in another department, and renting time from a service bureau."

Mr. Clennon further stated, "It is my belief that such a procedure will also reveal to the individual the logical choice of computer type."

Bob Moore, Standard Electric Time Co., explained the procedure used by his company in introducing the chief engineer to the application of the McIlroy analyzer. Said Mr. Moore, "Our first approach would be to ask questions concerning the company's present method of network analysis." He would then try to determine how much of the basic information data is at hand in a usable form. He then talks over load growth, load data, pressure records, and similar subjects. General maps and a few detailed maps are also helpful under examination. Mr. Moore then suggests a procedure to be followed and answers questions about pin-pointing loads in the system, accuracy of maps, representing new installations, etc. Along with this, they suggest that the chief engineer correspond with analyzer users or visit the installations if possible.

Analyze own system

"The best method of studying the application of the analyzer is to run an analysis of one's own system," according to Mr. Moore. He strongly advised the use of the analyzer at one of the existing concerns that operate analyzers on a consulting basis.

Dr. Neisius concurred with the general feeling that the most efficient and convincing method for one to become aware of computer operations would be to utilize the services of a computer service bureau for sample runs of distribution problems.

A spokesman for IBM gave a very detailed report of how his company approaches this problem. "We would suggest that he arrange for several of his most competent and experienced engineers to meet with one of our mathematicians. This group should decide what the major engineering uses of digital computing are in this particular company. Our mathematician would then meet with the engineers most familiar with each application, in turn. He would attempt to derive from them the most pertinent facts about the problem to gain a preliminary idea of whether or not the problem is actually solvable on the kind of equipment being considered.

"Ultimately, he would hope to obtain a complete mathematical description of the problem. At this point, it is important that the company's engineers work with our mathematician in deciding upon a method of analysis, and then the preparation of a program for a particular computer. In the process of performing the analysis, and completing the program, the company's own personnel should become familiar with the techniques involved and with the nature of the computer logic. Following the successful testing of this first problem, they should be in position to investigate in a similar way the other applications."

Q Will the application of analogue and digital computers for predicting the physical parameters and design of a distribution system 10 or 20 years in the future be a practical one? Does management generally accept this concept?

Mr. Starr pointed out that the gas industry cannot take on any avoidable competitive handicap if it is going to enjoy success in its competition with other sources of energy. It is his opinion that every available tool must be applied to make every construction dollar produce its maximum in effective performance so that it will return more than its annual charges that it inevitably collects. In his words, "So long as sales maintain a satisfactory growth rate, the application of calculators to distribution problems soon becomes mandatory. I believe management in general does subscribe to this concept, in principle at least."

In the opinion of an engineer from the gas industry, Charles W. Beggs, management at times is a bit slow to accept new devices such as the computers, but it appears that the ice is broken and that the computer concept will spread throughout the higher echelons very quickly. "The use of computers for prediction the design of a distribution system 10 or 20 years ahead is with us now," Mr. Beggs declared.

Ed Trunk, another gas industry engineer, made the point that under our present economy, distribution facilities are expanding to take care of the ever-increasing system load and the economy at this time plays its part in making the cost of expansion what it is today —high. He knows, of course, that management is aware of this situation and accepts the need for planning for the development of future gas distribution requirements. Mr. Trunk gave the ex-

Computer symposium... Almost completely automatic operations foreseen for the future

ample of the interest in computers for distribution engineering as evidenced by the last two AGA distribution conferences as an expression of managements' becoming aware of these tools.

Another gas industry engineer, John Clennon, foresees this application for computers in the future. He concurred with the others in the thought that the heavy investments required to attach additional loads to a distribution system make the application of computers for predictions of this sort practically unavoidable.

"There is no question in my mind about the application of computers to distribution design and operation," said A. R. Bayer. "In this era of high costs and strong competition the cost of errors in distribution design are too high.

"The problem in this area is the prevention of overdesign as much as underdesign. This is naturally tied in with realistic evaluation of costs and of probable load growth.

"Management accepts the concept of of using computers on the same basis as it does any other concept; that is, does it produce an adequate return on the investment or, put another way, does a computer cut costs? Computers of the simpler types are now in wide use for billing and accounting functions because the savings in their use in these fields is readily apparent. When measured against the cost of construction for distribution expansion, the savings resulting from the use of computers are also readily apparent. Many distribution problems can now be solved which were rarely attempted in the precomputer age because of the tremendous time, and therefore cost, involved in hand calculation methods."

On this subject, Frank Ladwig said, "If management of a particular company generally accepts the work of the company's planners, using hand methods and equipment with a limited scope, it would appear that they would accept the predictions obtained using the powerful computers that have an unlimited scope."

According to Bob Moore, "Acceptance of computer application varies in each company. In some companies, the engineers are very anxious to analyze their systems with an analogue computer, but management has thus far failed to give approval. In other companies, the usefulness of computers has been seen by top management, but since the computer must be more or less accepted by everyone who will use it or contribute data to it, complete approval has been somewhat retarded."

Q What about the future of computers in the gas industry? Through the use of data loggers, analogue-to-digital converters, and other tools of the automation engineers with computers, can you imagine an automatic distribution system in the not-too-distant future?

Because of the nature of the fuel and of the manner in which it is transported, the idea of a completely automatic system borders on the fantastic and should be approached very cautionsly. It was felt, however, that the time is fast approaching when the gas industry should bring itself face to face with the question of whether a completely automatic system might some day be possible. The panel members were frank in giving their opinions, which ranged from moderately conservative ideas to imaginative acceptance.

For instance, James H. Starr reported, "It is interesting to me that this same question has been a recent subject of discussion with respect to electric systems, with capable engineers supporting both the affirmative and the negative. My own opinion is predicated on the fact that, within the foreseeable future, no computer will be able to perform any operation which has not, first, been anticipated by its designer and 'taught' to the computer. Since unforeseen emergencies do occur, we cannot yet hope to build into a computer the ability to respond correctly to any situation that may arise. The possible consequences of computer response to conditions arising through some unpredictable accident are too serious to accept. While continuous automatic indication of ideal distribution dispatching may well be commonplace in 20, or 10, or even 5 years, there must be retained at least one element of human judgment with full power to veto any operating order which the computer may produce."

Standard Electric Time Co.'s Robert C. Moore presented the opinion of the other analogue computer manufacturer on the panel by indicating that, "Electrical and mechanical analogies can be made for any functions in a gas system. It has been said that digital computers are able to solve any problem for which an equation can be written. Remote control devices, transmitting and receiving equipment, and other useful tools have been developed and improved in the past few years. New methods and equipment for bookkeeping and accounting have increased the efficiency, accuracy, and speed of handling many paper work operations. It stands to reason that the so-called 'automatic' advances will be made in gas distribution systems during the next 10 to 20 years.

"There are some functions in a gas distribution system which would be very difficult to automatize. Functions dealing with the consumer, such as customer service, can hardly be made automatic. This is one limitation on the advance that automation will make in the gas industry. A more important limitation will be the capital outlay and equipment investment that the industry will be willing to make."

To explore further into computer equipment representatives' answers, we can turn to the digital computer group represented on *GAS'* latest computer symposium and first consider the short, but astute, reply from W. V. Neisius, Logistics Research Inc.

"The answer to this is easy—I wish the actual fulfillment were as easy." Mr. Neisius said. "Certainly the integrated processing control will be affected but will require careful planning and a sound approach to become truly effective."

Frank W. Ladwig representing another digital computer manufacturer, Burroughs Corp., gave us these

thoughts: "Everything we see in the future for computers indicates an increasing integration between units of the system. However, it is our considered opinion that the developments will come in an evolutionary manner rather than in a revolutionary manner. The desire for automation in some quarters is so strong that it would surprise us if many of today's dreams did not come true in the future."

The thinking of the gas industry representatives was as follows: Charles W. Beggs—"When one has used a network analyzer to solve his flow problems he becomes very much aware of the effect of various sources on each other as to flow and pressure. He will soon find that he can't do what he wants without a helper of some sort. Perhaps it is a telemetric gauge. It may be a push button-operated sectionalization valve or it may be a remotely operated regulator loader. All of these things automatically become necessary as the system grows and gets more complicated and careful studies of cause and effect are made.

"The central recording of flows and pressures and totalization of flows from pipelines to avoid penalties due to overdraft are with us now.

"Automatic cut in and out of regulators and meter runs is an accomplished fact.

"The business is becoming more and more automatic all the time.

"We have had automatic storage plants and automatic pumping stations for some time.

"The all-directing brain behind the system is the load dispatcher who must still supervise operations and always will have to be on duty to pick up where automation fails, but he needs a lot of help to guide his mental functioning rapidly in this rapid and expensive age.

"I think that probably some master divice will be produced which will auotmatically keep track of all the categories of gas available and the flows at each of the meter stations in operation and working from punched cards to cover provisions will advise the load dispatcher how to operate with the cheapest gas and without penalty. In all probability it will be wired to the weather bureau so that anticipated weather changes will automatically set up new schedules for manufacture or withdrawal from storage or repumping of gas or may even open or close system sectionalizing valves and will certainly automatically raise regulator pressure upon approach of cold weather.

"However, I cannot visualize the displacement of the directing brain of a few men in each system because of the frightfully important position of gas in the public interest which must be maintained at all cost as a safe, dependable and efficient fuel."

E. F. Trunk—"The idea of tying computers to control equipment to produce an 'automatic distribution system,' as *GAS* calls it, does not seem impossible to me. Present use of telemetric and remote control equipment has already gone a long way to produce just that. How much farther it will go in the future, and just how fast, is entirely a question of economics. In this instance, however, I use the term 'economics' in a very broad sense, broad enough to include two cardinal principles of the gas industry—*dependable service and safety*. Strict attention to these principles is probably why we gas men are often accused of being slow to adopt new ideas and equipment."

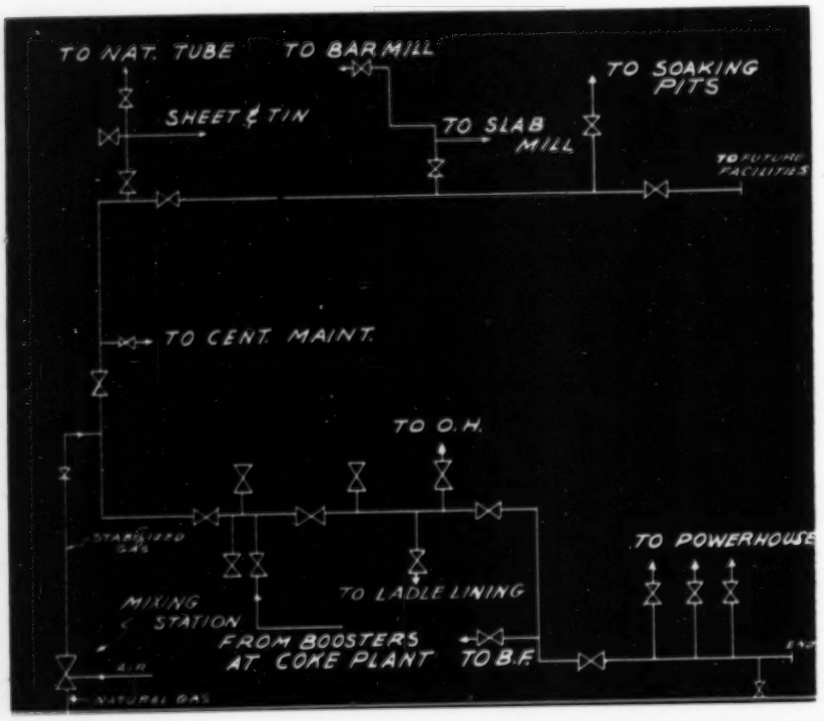
John P. Clennon—"It would appear to me that the future of computers in the gas industry is unlimited. The first paper presented to the American Gas Association on computers was in April 1951. At that time there was much speculation as to the future of such a device. Today, four years later, the speculation is not 'will it work' but rather 'what is the best type' and 'how do I go about using such equipment.'

"The only objection to having an automatic distribution system is money. It is reasonable to expect that in the future there will be greater use of equipment of this type, e.g., computers, analogue-to-digital converters, telemetering, remote control stations, etc., than at present." ■

The engineer's problem is in the prevention of over-design as well as under-design, in the opinion of A. R. Bayer, Brooklyn Union (center). At left is Peter Wile, GAS magazine, and W. J. Neisius of Logistics Research Inc. is at right.

Fairless Works achieves close control in mixing fuel gases

By **JACK E. WEBBER** • United States Steel Corp.



This is the system (left) that serves the Fairless Works. Variations in proportion of sendout gases require very close control (Fig. 1).

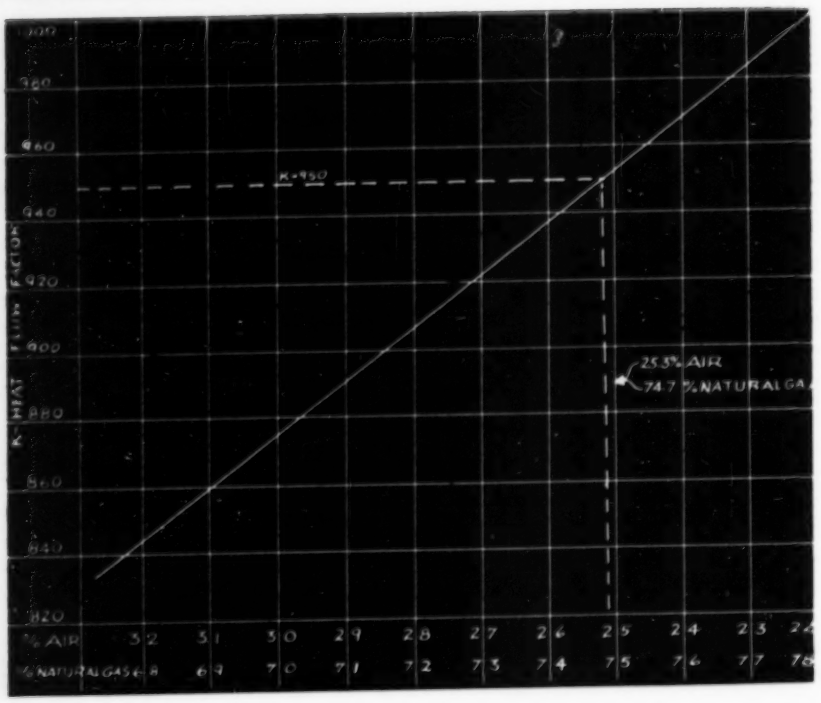


Fig. 2. Desired flow factor can be maintained by injecting a mixture of 74.7% natural gas and 25.3% air, by volume.

STEEL works of the size of United States Steel Corp.'s Fairless Works require complete distribution systems to convey gas from the delivery station to the points of utilization within the plant. At Fairless, it was necessary to construct a mixing station to mix natural gas with the other fuels, and an intricate control system had be developed and given in-operation tests to prove the design.

The gas distribution system at Fairless is U-shaped, consisting of about two miles of 36-in. and 30-in. line with the end portions swaged to 24-in. and 20-in. The plant of the National Tube Division is supplied with fuel through an 18-in. take off from this system *(Fig. 1)*.

The base fuel supply is coke oven gas from two batteries which are underfired with part of their own gas. The gas is compressed by steam turbine boosters to the normal operating pressure of the system—9.5 to 10 psig.

The coke oven gas enters the main on one of the legs of the U. A minor portion of the gas is required by facilities on the end portion of this leg, being utilized as drying gas in open hearth and blast furnace operations and for pilot and standby fuel for boilers. The remainder of the gas flows toward the mixing station, and one to the mill area and the plant of National Tube.

The controls on the system, as orig-

inally furnished by the coke plant contractor, were such that the speed of the booster would be regulated by line pressure with an override from the position of a gas holder installed upstream from the booster station.

From fuel balance calculations, it was apparent that an auxiliary gaseous fuel would be necessary when all consuming units then under construction were placed in operation. Negotiations for a natural gas contract were begun and the plans for a mixing station were formulated.

In the early stages of the "start-up" of the plant, more gas was produced than was required because of the low mill load. Operations of the gas distribution system were fairly smooth, and with the gas holder raised to bleed position, the system was controlled by line pressure. However, when the larger fuel-consuming units were placed on the line, the problems of fuel mixing were immediately encountered.

Since the finishing mill capacity exceeds the capacity of the steelmaking facilities at Fairless, continuous operation of all units is not maintained. This causes a fluctuating load on the fuels system. It was apparent that it would be impossible, under these conditions, to maintain combustion control by injecting pure natural gas into the main. Because of the fluctuating mill load, the gas delivered to the consuming plants could contain from 0— to 100% natural gas. This would cause the Btu value and the specific gravity of the mixture to vary over a wide range. The concept of the so-called heat flow factor, Knoy formula, or as it is called in England, "Wobbe Index," is derived from the basic formula of flow through pipes and is most easily explained by saying that the heat input is in direct relationship to a figure found by dividing the Btu value of a gas by the square root of the specific gravity.

The mixing problem could be illustrated by *Table 1*.

Note that the coke oven gas sample has a Btu value of 565 and a specific gravity of 0.355, giving a heat flow factor (K value) of 950.

The natural gas has a constant heat content of 1060 Btu/ft and a specific gravity of 0.60, giving a heat flow factor of 1370.

With this varying heat flow factor,

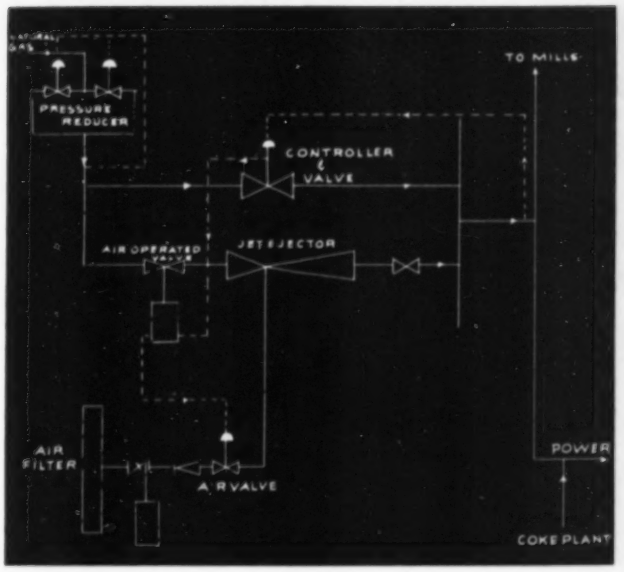


Fig. 3. Schematic diagram of mixing station with its original controls.

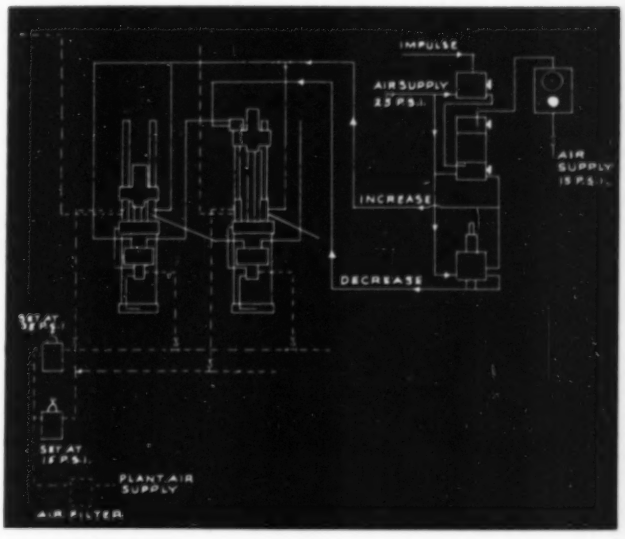


Fig. 4. Booster control system that was designed to deliver quantity of coke oven gas available regardless of mill load.

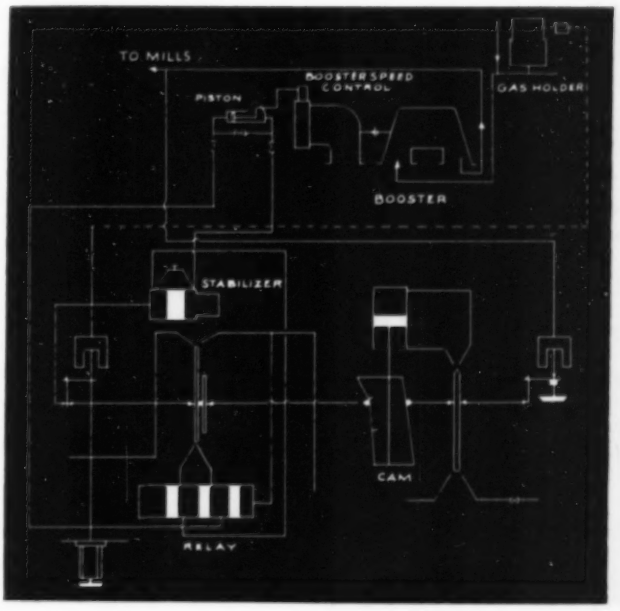


Fig. 4. (continued). Schematic of booster system which eliminates rapid rise and fall in demand on coke oven gas.

GAS exclusive

Prior to mixing station installation

With original mixing station control—mechanical pilot

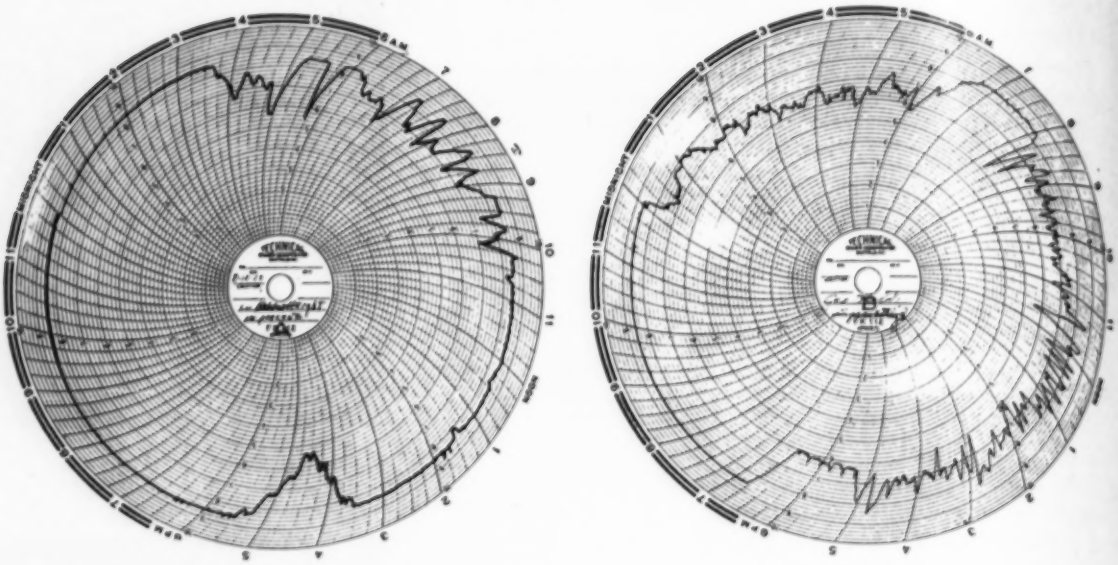


Fig. 5. Percentage of holder travel.

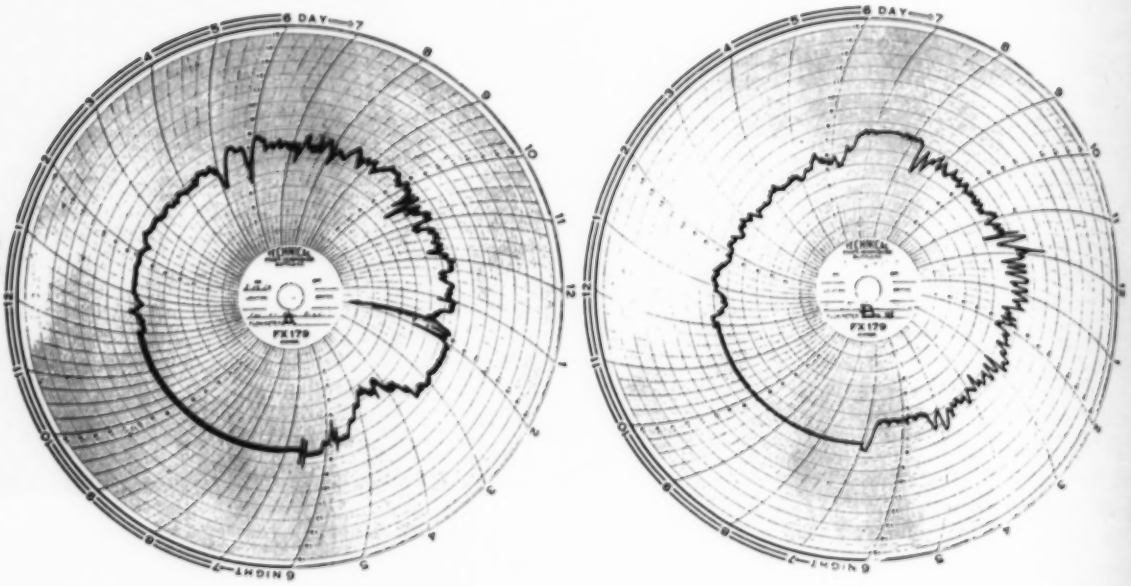


Fig. 6. Line pressure at booster at same stage of operation.

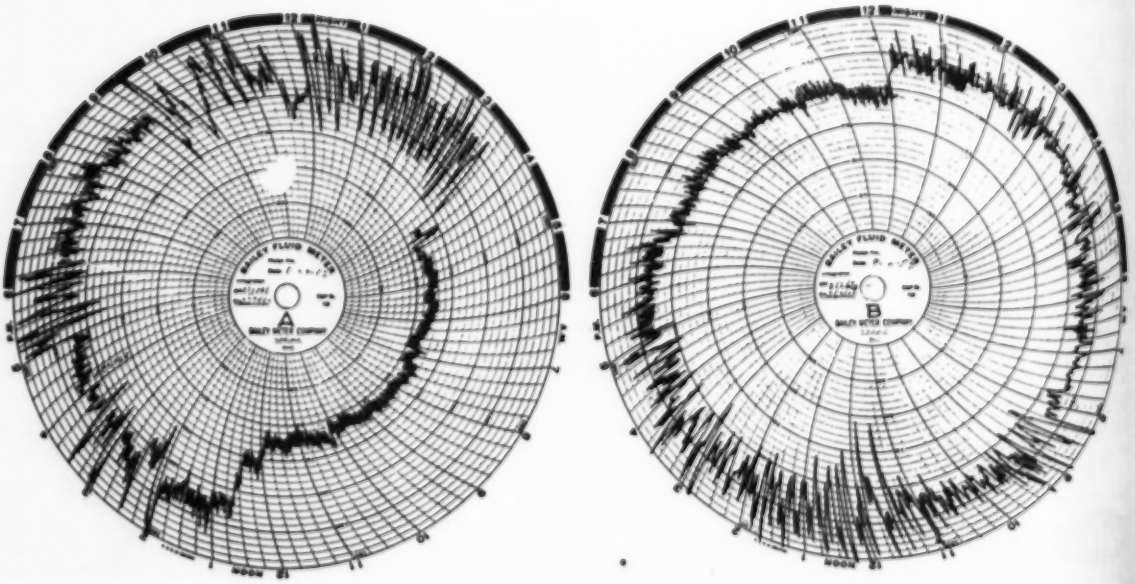
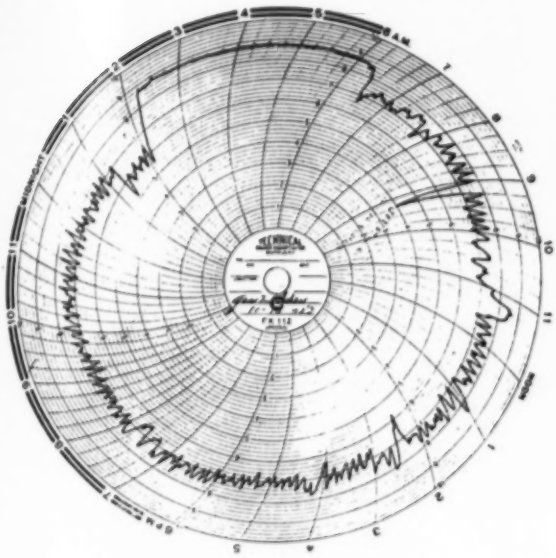
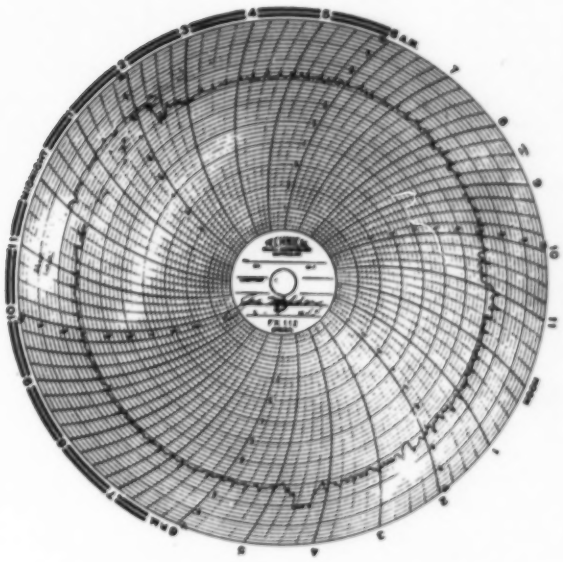


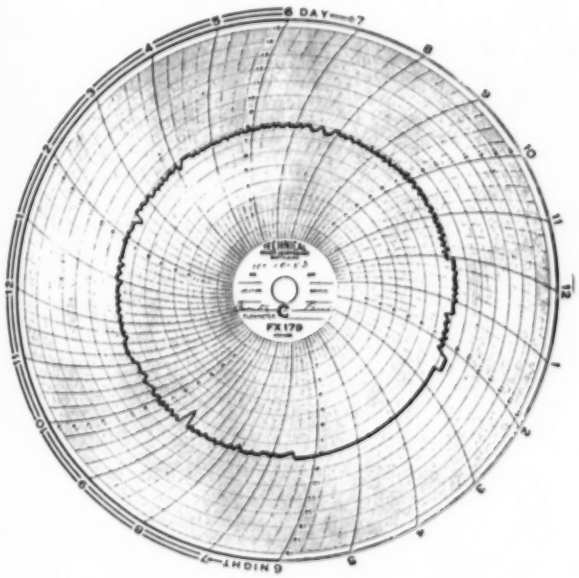
Fig. 7. Mill gas flow at same stage of operation.

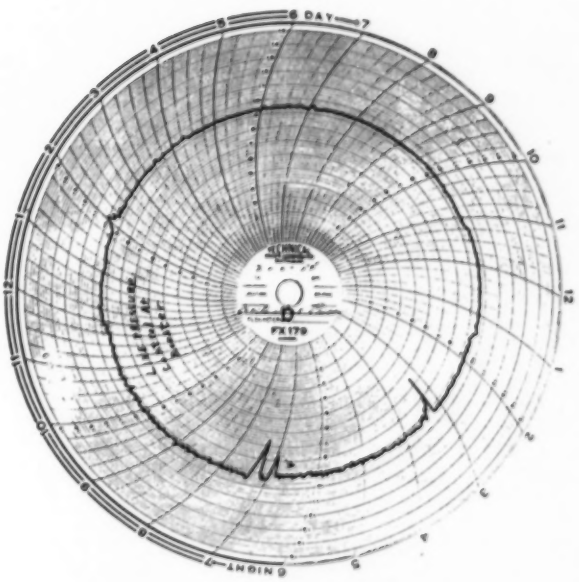
With derivative differential air loading control

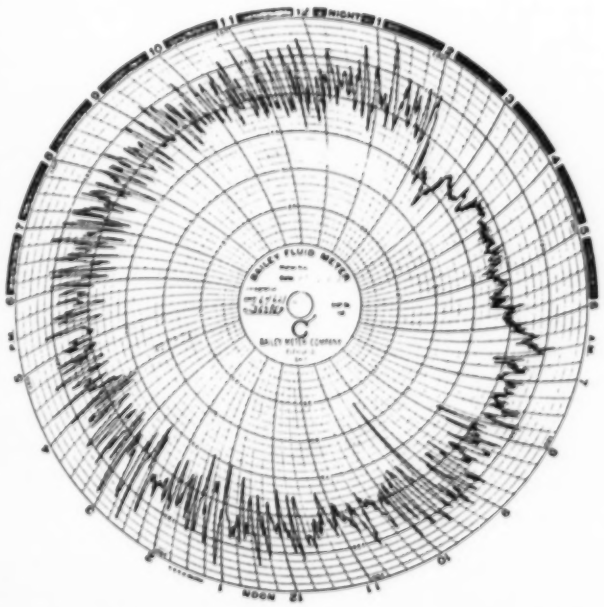
With holder position control

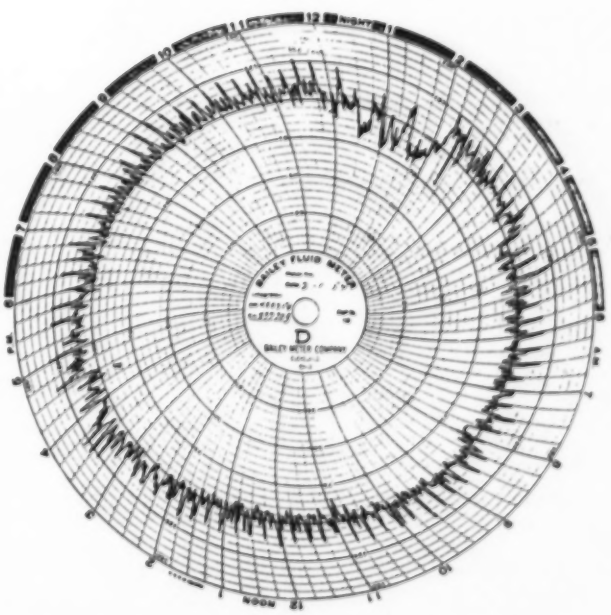












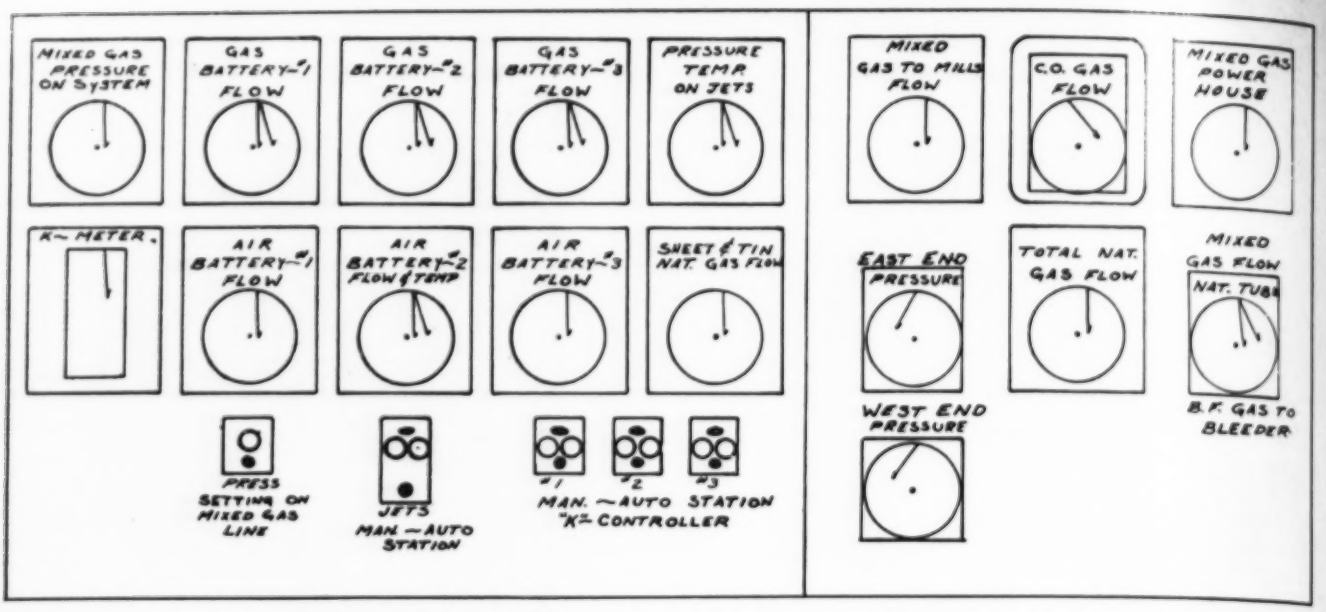


Fig. 8. A mixing station operator watches operations by means of this control panel.

the proper operation of metering installation and fuel-air ratio controls becomes impossible because both of the initial impulses originate from a differential across an orifice, and this differential varies with the change in specific gravity. For this reason, a station was designed to permit gas mixing in such a manner as to keep the heat flow factor of natural gas constant with coke oven gas. It was felt that this could readily be accomplished by mixing air with the natural gas, thus reducing the heat content and raising the specific gravity which, in turn, would produce the heat flow factor.

From the graph on *Fig. 2* it can be seen that the desired flow factor of 950 can be maintained by injecting a mixture consisting of 74.7% natural gas and 25.3% air, by volume.

TABLE 1. CHEMICAL ANALYSIS OF GASES MIXED

Coke Oven Gas		Natural Gas Added	
H_2S	0.7	H2	0.0
CO_2	1.4	CO	0.0
ILL	2.6	CO_2	0.8
O_2	0.5	CH_4	92.8
CO	5.4	C_2H_4	0.0
CH_4	30.2	C_2H_6	4.1
H_2	56.0	C_3H_6	0.0
N_2	2.8	C_4H_8	1.2
C_2H_6	0.4	n-C_4	0.2
	100.0%	N_2	0.9
			100.0%
Specific Gravity	0.355	Specific Gravity	0.603
Btu	565	Btu	1060
K	950	K	1370

Natural gas at 125 psig was available; therefore, it was decided that a jet compressor station utilizing the energy of 75 psig gas to compress the necessary air and force the resultant mixture into the fuel system would be the most efficient and economical method.

The station consisted of 15 jets, in three batteries of five each. Each jet was capable of passing 100,000 Scfh of natural gas at 75 psig upstream and 10 psig downstream pressure, and compressing with it a maximum of 42,000 cfh of air.

Fig. 3 shows a schematic diagram of the mixing station with its original controls.

As originally conceived, the pilot mechanism consisted of a controller and valve, the controller receiving its initial impulse from a change in pressure in the gas main. Assuming there was a drop in pressure, indicating a need for gas, the regulator, receiving such an impulse, would cause the valve to open delivering undiluted natural gas into the line at a maximum rate of 150 Mcfh. When the valve reached a completely open position, it operated an air relay which transmitted two signals, one to the "increase" side of the control air header, and another back to the controller causing the pilot valve to partially close. The increase signal actuated a pilot valve on the first jet, causing it to open. At an open position, two more air relays were actuated, one opening a diaphragm valve in the air line ahead of the jet, the other allowing the next increase impulse to bypass the open jet control in order to actuate the second jet.

If the pressure in the main continued to drop, the controller valve would return to the full open position, again transmitting the increase signal causing another jet to open. In this manner, the full 15 jets could be used in sequence. When the line pressure again reached the desired point, the inverse would occur. The controller valve would go to a closed position, transmitting a "decrease" signal, back-off from the closed position, and then, if further reduction in volume was indicated by the line pressure, would continue to remove jets from service.

The mixing station was put into service with this control system and with the control on the coke plant booster as mentioned.

Because of these extreme fluctuations in the fuel load, it was immediately apparent that more sensitive control was required. In attempting to increase the speed of the controller, several types of relays and pilots were placed ahead of the controller in order to magnify the impulse transmitted by a smaller change in line pressure. Operations were improved somewhat by these modifications. Generally, however, the point was being approached where it appeared that the lag was being introduced by the attempt to use any type of intermediate control valve ahead of jet control proper. The problem of direct maintenance of line pressure from the operation of the jets was then considered.

With a derivative unit, which tends

Mixing fuel gases...The speed of the booster is controlled from a fixed holder position

to magnify any changes in pressure, a conventional controller was installed to which two transmitting lines were attached. The output signals on these two lines were balanced at approximately 5 psig and a reversing relay was placed in one of these lines between the controller and the decrease signal line to the jets. The other transmitting line was connected to the increase signal line. Under this control system, a drop in pressure on the main would cause an increased pressure on the increase transmitting line, and a decrease on the decrease transmitting line, opening the first jet and setting up the same sequence of operation as existed in the initial operation. The inverse would occur with an increase of pressure on the main. Since both the increase and decrease pilots operate at about 9 lb, the almost instantaneous operation of air loading from 5 psig to 9 psig has replaced the controller valve with its inherent lag. With the installation of this control system, mixing station operations have been relatively well established.

At this time there were three separate controls on the system. The first was the line pressure control on the boosters, the second was the holder position override to the booster control and the third was, of course, the mixing station pressure control. The major control exercised by the mixing station caused a slight, but continual, fluctuation in line pressure which had a highly magnified effect on the speed of the booster and the gas holder position. If, for example, the mill load was suddenly increased, not only would the mixing station immediately go into operation to meet the demand, but the speed of the booster would be increased in an attempt to offset the pressure drop, causing the gas holder to fall to the low position, which, in turn, would reduce the booster speed. As in normal operations, practically all coke oven gas available for outside use was being pumped into the system; that is, the effect of small change in line pressure would cause an effect far out of proportion with their capacity to correct the situation. It was then decided to control the speed of the booster from a fixed holder position, allowing the booster to deliver only the total amount of coke gas available for outside use regardless of changes in mill load. *Fig. 4* shows the redesigned booster controls.

This change was accomplished with the existing control by reversing the impulse lines from the pressure control and the holder position override, and by reversing the transmission lines from the front of the controller. Since the various revisions have been made, the system has been operating with these facilities:

1. A conventional holder position control on the coke plant booster with a high pressure override that will reduce the speed of the booster and allow bleeding of excess coke gas.
2. Control of line pressure by the mixing station, utilizing a common derivative unit followed by a controller and reversing relay at the initiating control point.

Mill operations are so scheduled as to utilize all of the available coke oven gas. In addition, the mixing station has supplemented this supply by as much as the full capacity of the station (15 jets of 1.5 MMcf of natural gas). The minimum gas contract allows enough gas to maintain line pressure from the station while certain large consumers are using Bunker C oil during curtailed gas supply due to cold weather.

Fig. 5 shows four charts indicating the percentage of holder travel:

A. Prior to mixing station installation.
B. With original mixing station control, that is, mechanical pilot.
C. With derivative differential air loading control.
D. With holder position control.

Fig. 6 shows line pressure at booster at the same stage of operation, and *Fig. 7* illustrates mill gas flow at these stages of operation.

The station was manually set to attempt to maintain a heat flow factor corresponding to design on all plant orifice meters, which was 560 Btu and 0.37 specific gravity. The variables at the mixing station were weight of air (humidity), and temperature of the gas itself. After considerable testing of the coke oven gas, it became apparent that the heat flow factor of the gas was varying as much as 10%, either way, from the original average figure.

Combustion checks throughout the mill confirmed this. Some of the smaller, more critical burners had shown evidence of the critical nature of this heat flow factor. In checking on available measurement and control devices, it was found that the true picture of heat flow conditions could be represented only by a combined record of a calorimeter and a specific gravity meter. Since this, in effect, gives a heat flow factor result, it was felt that a heat flow factor meter on a K-meter with a transmitter would rectify more nearly the error of varying heat flow factor.

The plan for the immediate future is to install a K-meter on the mill side of the mixing station intersection and use the air capacity of the jets to control the heat flow factor of the resultant mix of coke oven gas, natural gas, and natural gas-air mix. The limitation imposed by such control is the low load that exists at certain times on the mixing station thus limiting both the amount of air or natural gas available to temper the coke oven gas as needed. It is felt that the coke oven gas could be stabilized very satisfactorily with either jets or a small blower ahead of the boosters, and an investigation is under way to explore the feasibility of such an installation.

It is also planned to install heating coils in the incoming air headers at the mixing station, to prevent freezing in the jets. This condition which has been experienced occurred several times during periods of high humidity and low temperature.

The only other problem that the gas system has imposed is the difference in flame characteristics between coke oven and natural gas. Burner experiments have been concluded and data indicate that on the smaller burner installation, where these flame characteristics are important, a modified burner can be used to attain the desired result.

All fuels handling, ordering, and dispatching is accomplished from an office in the mixing station by a fuels dispatcher foreman. There is also a mixing station operator who watches operations from the room that houses the control panel shown on *Fig. 8*. The fuels dispatcher also supervises maintenance of oil and gas lines, allocation of fuels, ordering, and receiving fuel oil, operation and maintenance of the bulk fuel-oil pump house and the hot strip mill pump hours. ■

Fig. 1. Approved materials handling techniques will have a beneficial psychological effect upon the incentive workman. Power conveyors such as this circulating overhead type at Public Service Electric & Gas Co. will ease his workload.

Performance of a meter shop under an incentive wage rate

By GEORGE K. BACHMANN, General Superintendent of Meters
Public Service Electric & Gas Co., Newark, N. J.

ALTHOUGH the field of labor wages is largely that of the industrial relations department of a company, particularly bargaining procedure, the meter shop operator can affect enormously, in establishing shop procedures and equipment, the acceptance of incentive rates and the economy resulting from the use of them. The reason for the need of an incentive wage is that straight time pay, particularly when applied to production-type work as found in a meter repair shop, may well result in a mediocre labor effort sometimes referred to as the "gas company gait," which is due to failure on the part of management to provide an incentive—a real necessity in keeping up mental interest of the workman on repetitive operations. Greater production per square foot of available floor space is another reason for the need of incentive wages.

The experience and material detailed in this article result from the operation, beginning substantially in 1954, of a central shop called the State Meter Shop for Public Service Electric & Gas Co. Although this shop is rather a large scale operation, mostly concerned with tinplate meters, the concepts carried out with respect to incentive rate are, nevertheless, fundamental and applicable to small meter shops or hardcase meter shops as well. The use of incentives is receiving very wide attention today in many industries, including clerical. Although not widely used now in public utility work, it is stirring increasing interest.

Shop layout should embody axiomatic fundamentals of material handling for a number of reasons, one of which is the psychological effect upon the incentive workmen. The fact that meters and parts come close to the work station, at the optimum level on the floor in an uninterrupted flow, provides a set of conditions that must make it clear that management has done all it can to get out the work and that the workman has to "carry the ball" from there. The handling and transportation of meters between work stations should be non-manual if possible, and if manual, should be a separate job, not included in an incentive mechanic job of a higher evaluation. The necessity of meter repairmen to leave their work station to move meters or material for anything more than a very minimum time will counteract the benefits of the proper incentive rate for the job.

The use of meter hand trucks, gravity slides, or gravity roller conveyors is usually satisfactory for short-distance moving of meters or material and has often been expounded at distribution conferences. For longer distances, power conveyors must be used, either circulating overhead type making a closed loop around an area of the plant *(Fig. 1)* or the moving belt type, on one or two levels *(Fig. 2)*.

The use of a conveyor of the circulating overhead type may become rather involved as far as time study and incentive are concerned. At our state meter shop, where the conveyor circulates among eight progressive meter operations performed on eight groups of

This article has been adapted from a talk presented at the AGA distribution conference held in Cincinnati in April.

work benches from body tinning through body gassing and carries a reservoir of meters that circulate among these bench operations, there are some serious advantages and disadvantages. An advantage arises in that while the eight operations on the line are progressive (body tinning, diaphragming, casing-in, etc., through inspection), not every meter requires all operations.

For instance, a valve clean repair requires the first operation and the fourth, fifth, sixth, seventh, and eighth, so at the second and third operation bench location (diaphragming and casing-in), the meter simply passes by on its carrier without any handling. (This type labor saving is not possible with the belt-type conveyor.)

A disadvantage is that it is practically impossible to stock the conveyor at all times with meters balanced in quantity according to the work demand of the meter repairman and so there must be some waiting for work time included in the incentive rate. Despite the fact that in our situation 22 meters per minute pass each repairman, determination of this waiting time allowance is difficult as it varies continually, and it is not easy to arrive at a mathematical solution. In our case it was determined by sample observation over three or four days each on the various operations on the line. Some waiting allowances ended up high and some low as shown in *Table 1*. The repairmen will not stock meters behind their work bench while "waiting for work time" is being determined, but once the waiting time allowance is determined they will stock meters and cut down waiting time.

Our experience indicates it is wise as far as time study to use the circulating type conveyor among progressive operations only where there are "skipped operations." In the situation cited above our problem could have been simplified by using a belt type conveyor after the fourth operation on the line, as each meter is given the same treatment thereafter. Parenthetically, it may be remarked, however, that in the selection of a conveyor, time study is not the only consideration. Other factors may indicate the choice of a circulating type conveyor, particularly for automatic operations, and there are four satisfactory ones in the state meter shop.

We have avoided setting up an incentive rate in instances where an overhead conveyor takes meters through an automatic operation such as trichlor degreasing for paint preparation, or automatic paint spraying, because the efforts of the operator do not depend on the quantity of meters being processed.

The placing of meter intesting, ad-

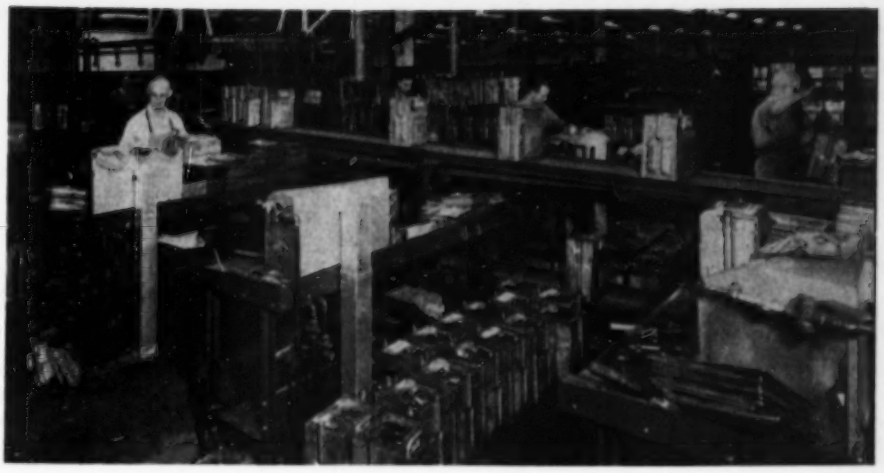


Fig. 2. The moving-belt type conveyor, which operates on either one or two levels, is also helpful to the incentive workman.

TABLE 1. TIME STUDY OF OPERATIONS AS SHOWN IN SAMPLE OBSERVATION

Operation: Tin Diaphragm Size 5

(Equipment used: Furnace, irons, screw driver, wire brush, solder and flux, wiping cloths.)

Operation	Standard Allowed Hours
Meter on bench	.0012
Clean	.0043
Flux	.0097
Remove index box	.0077
Tin index box area	.0034
Tin 4 top edges	.0111
Tin back plate seat	.0180
Clean top of meter	.0026
Clean gallery	.0051
Tin top seams of case	.0073
Tin adjacent sides and bottom (1)	.0100
Tin 2 adjacent side seams	.0065
Tin diaphragm seat side 1	.0177
Tin diaphragm seat side 2	.0128
Clean both sides	.0043
Wipe meter	.0039
Place meter on conveyor	.0011
Average meter waiting time	.0082
Standard allowed hours	.1349

Operation: Grind and Repack Valves Size 5

(Equipment used: Hook, packing ram, wrench, emery block, rotating emery disc. High pressure air.)

Operation	Standard Allowed Hours
Remove meter from conveyor	.0017
Remove valves	.0017
Grind valve covers	.0056
Grind valve seats	.0148
Blow out covers and seats	.0038
Open side boxes	.0058
Remove packing	.0085
Pack side boxes	.0256
Replace valves and test	.0086
Wash out with varsol	.0177
Waiting time	.0288
Meter on conveyor	.0015
Standard allowed hours	.1241

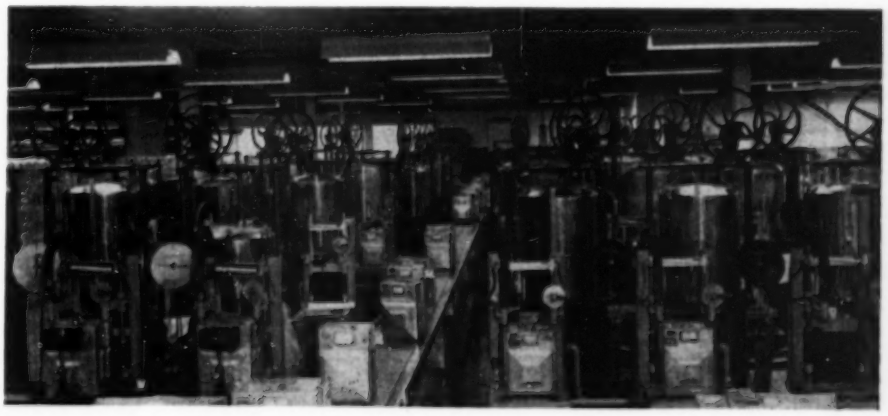


Fig. 3. All proving devices at Public Service incorporate automatic features, including push buttons and timing devices.

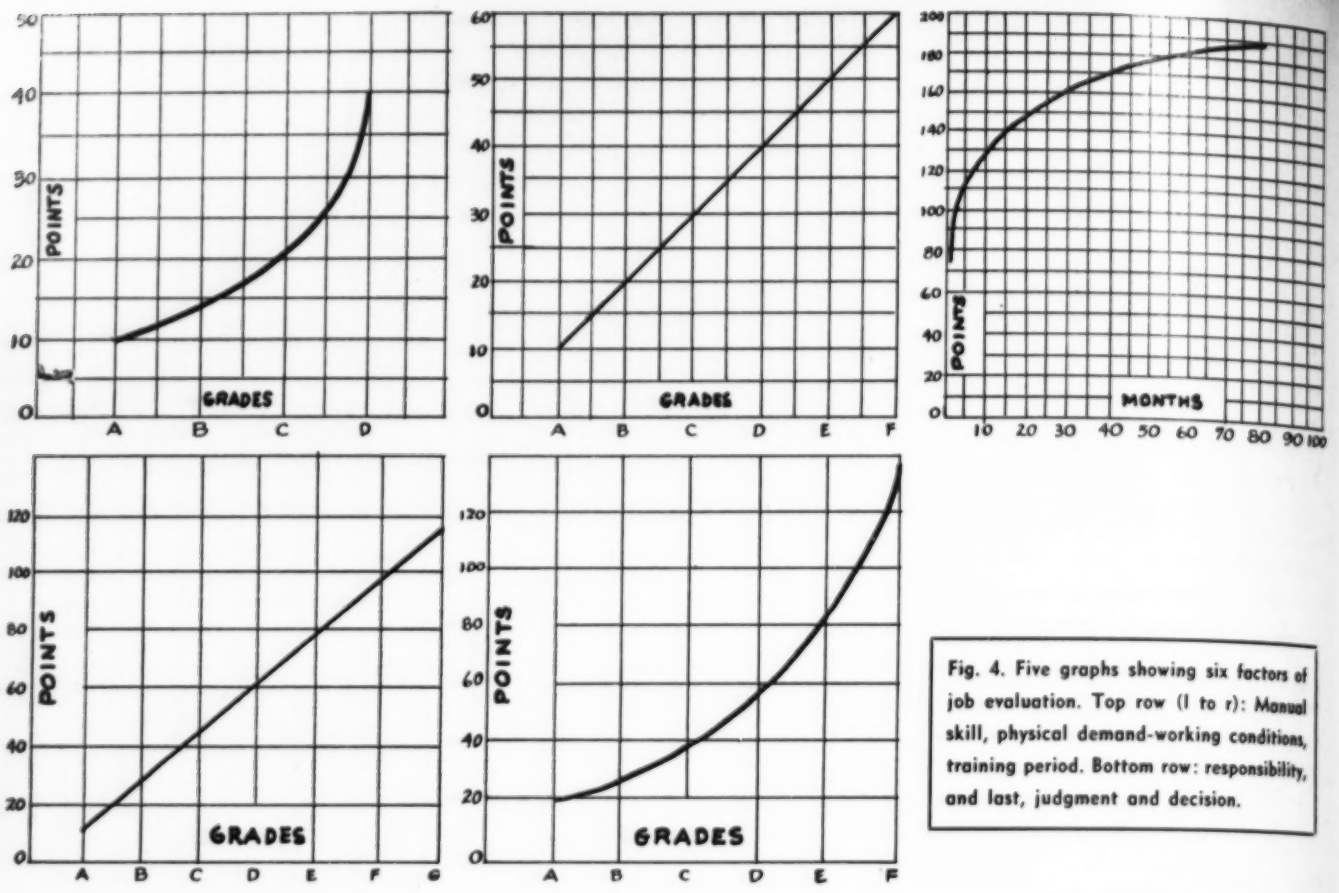


Fig. 4. Five graphs showing six factors of job evaluation. Top row (l to r): Manual skill, physical demand-working conditions, training period. Bottom row: responsibility, and last, judgment and decision.

justment, and final testing on an incentive wage has always had an obstacle, in that it was difficult, without a great deal of expense, to tell whether the work had been correctly and honestly performed. As these operations require much labor time, it was important that a solution be found for the state meter shop. There never has been anything to stop an unobserved meter tester, who is behind on his work, for instance, from taking test results on a shorter run than the prescribed one with ordinary manual proving equipment. Also in running a multiple prover installation, hurry on the part of the operator will result in frantic efforts to stop the test dial or crank tangent at the final stop mark with resulting inaccurate test information.

All meter test equipment at the state meter shop eliminates nearly all possibility of the voluntary or involuntary errors described above, as the length of the run is built into the equipment.

All proving devices, as shown in *Fig. 3*, incorporate the features: (1) the meter tester uses only push buttons for the operation, (2) need pay no attention to the test operation after it is started, (3) anytime after the test run is completed he can observe the recorded results of the test.

Each of the four types of equipment has three control buttons. Their purposes are:

No. 1—Jog. This button opens a solenoid valve which feeds air from the prover to the meter. It is used to run or jog the meter ahead to starting position, etc. It is used, with the rate valve closed, for the pressure tightness test for meter and connections. The solenoid valve referred to stays open only so long as the push button is manually held down.

No. 2—Start. This button when pushed (then released) starts the run.

No. 3—Recycle. If it is desired to stop

SAMPLE JOB DESCRIPTION

Tinning Meters

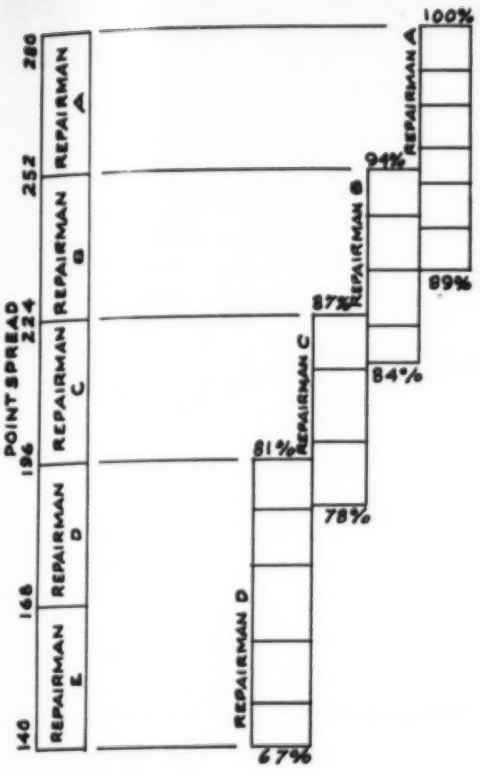
Description: Wire brush all rusty or corroded places to a bright surface to permit tinning.

Apply solder flux. After fluxing, tin as required. Remove all puttied glass index boxes. Remove solder seal index boxes in case of broken glass. If box cannot be removed, remove broken index glass. Smooth out all the solder drippings on exterior of meter. Wipe down entire meter, including partitions, removing all flux. Using awl, mark repairer's number on back of gallery.

Valve Grind

Description: Remove valve covers. If necessary, buff on leather to remove deposit of gums or oils. Grind on grinding wheel until it is apparent to the eye that no high or low spots exist. Slide surface of valves should have criss-cross pattern. Place covers in container of cleaning solvent.

If necessary, buff seats with leather block to remove gums or oils. Grind seats with blocks to same condition as covers. Remove side box packing. Wash entire table, including seats, with cleaning solvent. Wipe with towel and dry with high pressure air. Repack side boxes sufficiently so that when caps are snugged up, some packing dressing will ooze up around flag rod. If packed too tightly, it will cause undue friction, affecting capacity and causing later change in proof. Washer joints should be staggered as inserted in box, being packed evenly and loosely. Replace valve covers and connect to valve arms. (The upper valve arm normally will fit only to the back valve.) While turning tangent, tap covers for rock and arm lift. Repair as necessary. Using awl, mark repairer's number on right side of meter.



Application to present hourly time rate progression steps

Fig. 5. Job evaluation-hourly time rate (in percent of maximum Grade A rate) and its relationship in the state meter shop.

the run at any time after it is started by button No. 2, for any reason whatsoever, push button No. 3 is pressed (then released) to return the prover, etc., back to starting position again.

Of course the automatic proving equipment described does not make a meter proof adjuster adjust the proof of the meter. Quality control is needed for the purpose probably to a somewhat greater extent with incentive rate than with non-incentive, but our experience is that the cost of quality control is only a small one in either case. Quality control of intests is maintained by a re-run of 50 meters by an inspector and by making comparative analyses of the results with the first run of the regular intester. Adjustment on a short run has always been checked, even before incentive wages, with a longer retest by another operator. Even the retest is checked by taking a daily sample of 36 meters out of painted stock and observing the results. Careless meter testers will inevitably be discovered through these procedures.

Quality control is of course a problem on all operations of meter repair. Most of these can be simply observed for performance and quality. For instance, considering the repair operation of casing-in a meter, it is most obvious if the casing-in has been performed, and it is rather obvious if neat workmanship exists and routine procedure determines if joints are tight. Quality control of this kind must be maintained whether an incentive wage rate exists or not.

The procedure of setting the incentive wage rate includes five distinct developments which are the basis for application of the finished rate. These developments are:

1. Job description.
2. Job evaluation.
3. Time study.
4. Incentive and allowance.
5. Clerical system.

TABLE 2. JOB POINT EVALUATION

Job Name	Point Value
Intest	200
Top open	185
Case open	205
Dry clean	215
Remove dirt and brackets	215
Inspect diaphragm	265
Oil valves	175
Oil oilers	175
Gut	175
Tinning	245
Rediaphragm	280
Case-in	250
Valve grind	185
Parts fitting	280
Backplate	265
4 point	190
Body gas	230
Adjust	260
Retest	215
Top-in	240
Top gas	220

Job description should be as complete as it is humanly possible to make it. There are frequently fringe items on each job which one should go to some pains to include, because at a later date it is most likely that time consuming bickering will develop between progressive operational groups of meter repairmen as to just where one job finishes and another picks up. Examples of job description are given in the box on page 54.

Job evaluation

Job evaluation must have as a basis a predetermined weighting of the various factors that enter into the performance of the job. This weighting is empirical, based on experience, and varies with even the experts in the field. It is preferable to select one weighting of a reputable authority rather than attempt to design the weighting oneself. Some experience or concentrated thought on the application of the weighting is necessary for workable results. Five graphs covering the six factors are shown on *Fig. 4*. Analysis of points of two job descriptions are:

TINNING

Factor	Points
1	115
2	15
3	30
4	20
5	40
6	25
Total	245

VALVE GRIND

Factor	Points
1	95
2	10
3	20
4	20
5	20
6	20
Total	185

A summary of point values of many job descriptions is listed on *Table 2*.

The translation of job evaluation into dollar values will depend upon company policies as to the maximum time (hourly) rate on a non-incentive basis for the most skilled repairman and the minimum rate for the least skilled repairman. This policy is usually guided by overall considerations of all gas company employees. (The use of the word "repairman" is herein meant to cover all categories of meter shop workmen,

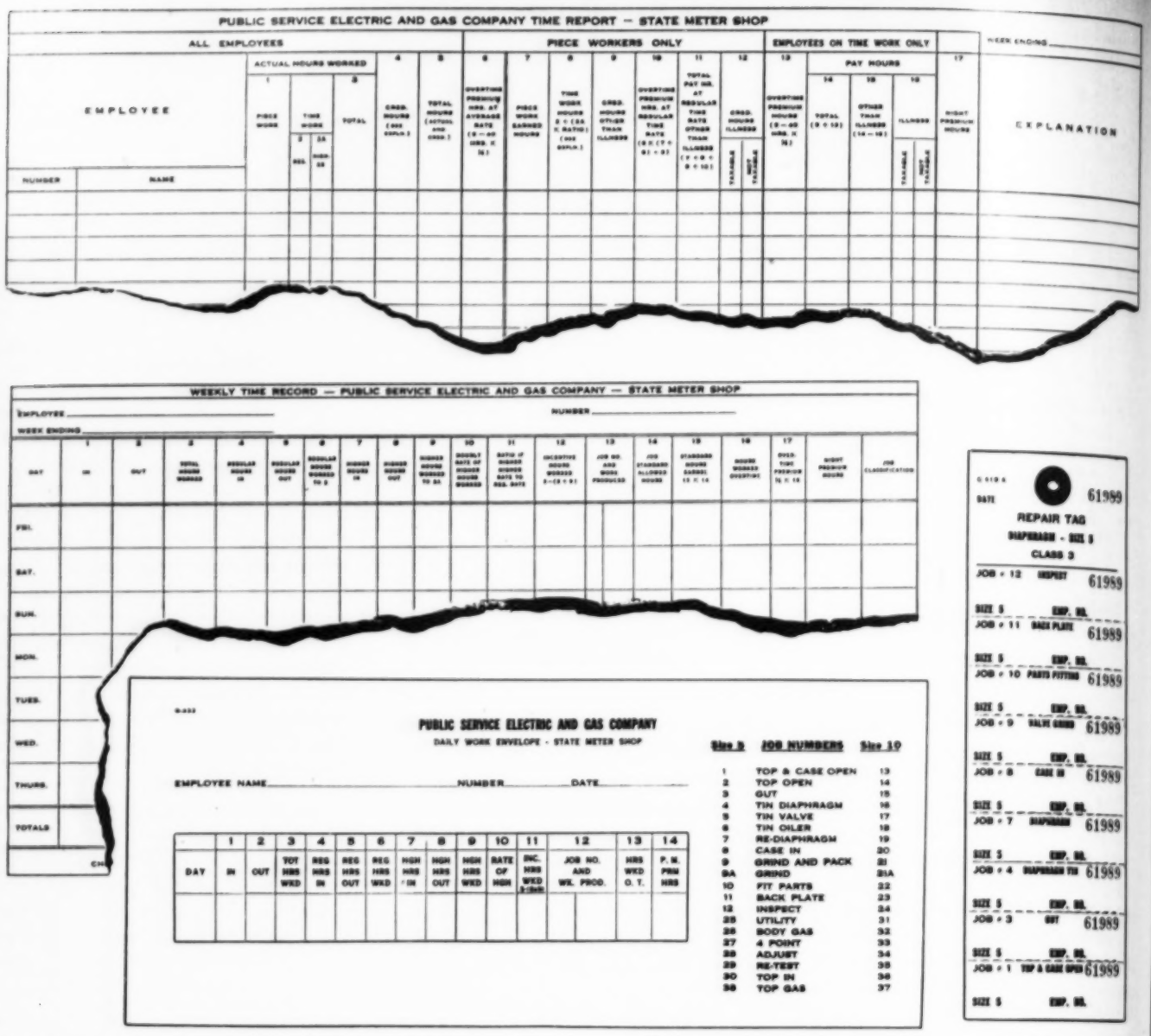


Fig. 6. These are the forms used by Public Service meter shop employees. They consist of a work ticket, an envelope in which the tickets are placed and on which the count is noted, a weekly time voucher, and the shop consolidated weekly time report.

whether a meter tester, a caustic tank operator, or a meter assembler, in the stricter sense of the word.)

Within the maximum and minimum rates, a decision must be made as to how many grades of repairmen, without having an unduly complicated rate setup, are necessary to give recognition to the assorted skills found in a meter shop. Our decision was to use five, which we believe to be a common number of rate distinctions in industrial rate practice. There were so few employees in the lowest or fifth category, that the fourth and fifth were combined into a single wage rate group.

Table 3 shows the distribution of basic hourly rates by job evaluation points according to jobs and graphically the relationship is shown on *Fig. 5*. In our particular situation we have automatic progression within a job category. The maximum progression rate of one category overlaps the minimum rate of the next higher category, a device to enable transfer to a higher category without reaching the maximum of the lower category, without interrupting the regular progression period and period increase. Neither automatic progression nor overlapping of progression rates have any significance with respect to job evaluation.

Time study allowance

Time study allowance for various labor operations was determined on the basis of a comfortable rate of effort which a repairman could sensibly keep up, doing good quality work, for most of an eight-hour day, day after day. Judgment as to the "sensible rate of effort" was entirely in the hands of the time study man, who must have some experience to do a good job. Repair work cannot be as sharply studied as production on new materials, so that some leeway in time study rate for the condition of used material in a meter repair shop must be made. Such considerations as "normal" rate of effort, sometimes being defined as the effort required to walk at 2.5 miles per hour, or dealing out 26 playing cards per minute, and that repairmen would work at over 100% of normal, were absent from our considerations. The time study result determined in our case was one which an average repairman's perform-

ance could easily reach, and which, if greatly exceeded, would lead to close scrutiny of the quality of the work. No limit on earnings is kept, however.

Incentive allowance

Allowance for time away from the work station, and an incentive allowance must be provided for the time allowance which will be the final figure for the pay of the job. In our case we recognized the following:

Morning break	15 minutes
Morning washup	10 minutes
Afternoon break	15 minutes
Afternoon washup	10 minutes
Bench cleanup	15 minutes
Personal, fatigue, delay	25 minutes
Total	90 minutes

(19% of the 8 hour day)

Incentive bonus in pay that would make it worthwhile for a repairman to keep up steadily at an established production rate, rather than coast along on his basic time rate, is a matter of policy, but would fall in general between 15 and 30%, having been allowed as 25% in our case. Under the allowance listed here, a time study job of say three minutes would be increased as shown in the equation below.

Our experience in setting the rate is that even though most fairly computed in accordance with the time study precepts described above, the quantity of production for earning the incentive bonus is so greatly in excess of the usual production in a gas company time rate shop, or even a shop in which non-scientific historical piece rate existed, that the incentive bonus production required seems astronomical to the meter repairman and he sincerely feels that is is unattainable. In the instance of the three-minute operation cited in the preceding paragraph, 130 required operations (390 minutes ÷ 3 minutes) required daily will be compared by the workman to the possible 75 he has been completing previously. A comparison of some production requirements before and after establishment of incentive wage rate is given in *Table 4.*

An industrial tempo of work in the meter shop such as found in most profit motive manufacturing plants had to be established. There was a war of nerves at the state meter shop as the crystallizing of time study allowances was proceeding between meter repairmen and management, as represented by time study men. It was well to listen to complaints of the repairman regarding the tentative production quotas, first to give everyone his "day in court," and secondly because there were some few factors to be accounted for in rate setting that the time study man had overlooked. It is most desirable, particularly when there has been a work method change, to allow the repairmen ample time, possibly as long as six months, to become accustomed to the routine of the job. A long period of training, which serves to give a workman plenty of time to overcome mental barriers to high production requirements will greatly help toward satisfied acceptance of the time study allowances on the part of the workman. We only allowed about three months for a trial period before establishing the incentive rates. It is now apparent that a few of the rates could have been trimmed a little closer, if more time had been allowed.

Now that a year of operation under the incentive wage has gone by, some of the soft rate operations are undergoing a method change and a restudy of the allowed time rates is being made. Without a method change a restudy

TABLE 3. JOB POINT EVALUATION AND RATES

Job Class	Job Name	Evaluated Points	Rates (In % of Max. Class A Rate Repairer)
A	Fitting	280	89% to 100%
	Utility	280	
	Rediaphragm	280	
	Backplate	265	
	Diaphragm inspect	265	
	Adjust	260	
	Solder smelter	260	
B	Case-in	250	84% to 94%
	Tinning	245	
	Top-in	240	
	Store meters	240	
	OK repair	235	
	Body gas	230	
C	Top gas	220	78% to 87%
	Retest	215	
	Dry cleaner	215	
	Case open	205	
	Intest	200	
D	4 point	190	67% to 81%
	Top open	185	
	Valve grind	185	
	Iron dressing	185	
	Gutting	175	
	Oil and test oilers	175	
	Oil and test valves	175	
	Parts tinning	170	
	Floor boy	145	

TABLE 4. COMPARISON OF REDUCTION REQUIREMENTS

	Former Production	Production Required to Reach 25% Bonus Earnings	Percent Increase
Intest	72 per day	150 per day	111%
Tinning rediaphragm meters	56 per day	73 per day	30%
Rediaphragming	33 per day	41 per day	24%
Backplating	57 per day	89 per day	40%
Topping-in	125 per day	218 per day	74%

$$\text{Allowance factor } \frac{480 \text{ minutes per 8 hour day}}{480 \text{ minutes} - 90 \text{ minute allowance}} \times 1.25 \text{ incentive} = 1.54$$

3 min. time study operation × 1.54 = 4.62 min. actual allowance

Pay for working 390 minutes ÷ 3 min. per operation × 4.62 minutes time allowance = 600 minutes (10 hours pay)

TABLE 5. STANDARD ALLOWED HOURS OF OPERATIONS AND EXPECTED PRODUCTION

Size 5 Diaphragm Repair

Operation	Standard Allowed Hours	Break Even Rate Per Day	25% Bonus Rate Pay Day
Intest	.0656	122	153
Top open	.0269	297	371
Case open	.0170	471	589
Dry clean	.0105	762	953
Inspect	.0085	941	1176
Gut	.0895	89	111
Diaphragm tin	.1349	59	74
Rediaphragm	.2408	33	41
Case-in	.1748	46	57
Valve grind	.1241	64	80
Parts fitting	.1308	61	76
Back plating	.1133	71	88
4 point	.0320	250	313
Body gas	.0503	159	199
Adjust	.0847	94	118
Retest	.0513	156	195
Top-in	.0458	175	218
Top gas	.0617	130	163
Tin case, machine	.0020		
Tin tops, machine	.0020		
Tin disc, hand	.0108		
Tin back plate	.0061		
Straighten case	.0054		
Straighten top	.0054		
Total	1.4942		
Supplementary			
Replace flag arm	.0458		
Replace cover arm	.2114		
Total	1.7514		

would undoubtedly run into labor opposition.

In our case the original time studies as well as job description evaluation were made by an employee of a consulting management firm, but maintenance (changes) in the rates, which will most assuredly be necessary to keep the rate schedule up to date, are made by a meter shop employee whom we have given some training in these procedures.

Under the rates designed for the state meter shop, it could be logical to expect that repairmen would all earn about 25% incentive pay. It is not wise to predict such a figure, as there is no way to forecast how hard the workmen are going to push themselves on their work. In our situation the average of all repairmen collectively is 30% incentive pay, with possibly 10% of the men individually rising as high as 50%. As long as the work is satisfactory, there is certainly no reason to curtail these individuals who have unusual drive on their work. There may be a feeling among men in other departments, such as the street or customer's service, that these meter repairmen are earning excessively. There is one sure answer to such complaints: invite the complainant, possibly a man spending his time outdoors, in automobile under no constant supervision, etc., into the meter shop for production work. The invitation will almost surely be refused. The prospect of remaining at a single work station performing a repetitive operation a maximum number of times, possibly next to a heat-producing piece of equipment under constant supervision, is not overly inviting to such individuals.

A pitfall to be avoided is to make sure that the basic time rate is not a historical one, which at a past date was made high, with an unrecorded connotation of expected high production. The considerations listed above applied to such a historical rate would produce an overly high rate of pay.

The actual time allowance may be translated into money piece rates, but generally they are not. Piece rates must all be changed when there is a general wage increase, causing great clerical work. The old time piece rate system generally did not have a weekly 40-hour pay minimum (for a 40-hour week), a labor standard requisite today.

The standard hour system, in which a worker is paid in earned hours based on the operation time allowance, with a weekly base rate minimum, has the advantage that the job rates, expressed in time as decimals of an hour, need never be changed for a wage increase.

Table 5 is a summary of the time allowance rate for a complete rediaphragm repair of a size five meter, which total 1½ hours pay, part of which is paid at various grade pay rates. The 1½-hour figure does not include replacement of not regularly new parts. The labor item we consider moderate and economical for this job, and also with all the other type repairs.

Clerical system

We have a breakdown by elements of each job labor rate. Several of these breakdowns are shown in *Table 1*. This breakdown is very useful in case of a change in job method, as the element time remains the same and need not be restudied.

Wherever possible, the state meter shop uses a perforated work ticket, from which the workman tears a stub as a receipt for his work. The stubs are placed in an envelope after count by the workman and so noted on the envelope. The contents of the envelope are spot checked by the payroll clerk, the daily results entered on an employee weekly time voucher, the weekly total of which is transferred to a shop consolidated weekly time payroll. These forms are shown in *Fig. 6*. While these forms look rather formidable, due largely to federal and state provisions, their execution is relatively simple.

The question arises in the minds of readers of this article as to acceptability of incentive wage standards by an organized labor group. Such groups often have a large majority of street department workmen or customers' service mechanics, and their decisions do not necessarily reflect the attitude of a meter repairman minority. The development and purchase of low cost disposable (non-repairable) meters is a fortunate development in such situations, in that it provides a competitive substitute for meter repairs. Cooperation with an incentive wage system is a desirable choice for an organized labor group to an alternative of a great reduction of meter repairs, or even discontinuance of meter repairs, through the use of disposable meters.

Part 8 in a Series

The New Gas Transmission and Distribution Piping Code

ASA—B31—SECTION 8

A background discussion by **FRED A. HOUGH**

Code's outline is pattern for top-managed maintenance plan

IN this eighth and final article in our series on the new ASA Gas Transmission and Distribution Facility Code, the section of Chapter 4 on pipe-type holders and Chapter 5, on operating and maintenance procedures for gas transmission and distribution facilities will be discussed.

The code defines and provides for two types of holders, which, because of their design and the materials used in their construction, are closely related to pipelines. These are defined in the code as follows:

"1. A pipe-type holder is any pipe container or group of interconnected pipe containers installed at one location and used for the sole purpose of storing gas. A pipe container is a gas-tight structure assembled in a shop or in the field from pipe and end enclosures. 2. A bottle-type holder is any bottle or group of interconnected bottles installed in one location and used for the sole purpose of storing gas. Bottle, as used in this code, is a gas-tight structure completely fabricated from pipe with integral drawn, forged or spun-end enclosures, and fabricated and tested in the manufacturer's plant."

Probably the most important code matter relating to holders of this type is the question as to whether they should be designed and constructed in accordance with one of the pressure vessel codes, or in accordance with the gas pipeline code. It was concluded by Subcommittee 8 that the design, construction, and testing should be in accordance with applicable provisions of the pipeline code rather than in accordance with the pressure vessel codes.

The basic reasons for this decision are:

1. If holders of this type are installed underground as required by Section 8, then all conditions of use are exactly comparable to the conditions of use of a pipeline installed in a comparable location. Consequently, the pipeline code fits more closely the conditions encountered in the construction and operation of these holders than does the pressure vessel code.

2. There are some important differences between the conditions assumed when a pressure vessel is designed and the conditions that can be assumed when a pipe- or bottle-type holder is designed. (a) Since the pipe- and bottle-type holders are installed underground they are less subject to fire and damage from falling objects. (b) When such a holder is designed, its exact location is known; consequently, the design can be made to fit the degree to which the public is exposed to holder hazards and the degree to which the holder is exposed to damage resulting from activities of the public. On the other hand, it is necessary to assume in the drafting of the pressure vessel codes that a pressure vessel designed under the code might be installed where its failure would result in injury to many people and that it will be installed where there is considerable possibility of fire damage.

Section 8 of ASA B31.1 contains a section (844) devoted entirely to pipe-type and bottle-type holders. The principal requirements of this section are:

(1) The holders of this type must be installed underground.

(2) If they are installed in streets or on private right-of-way where the owner does not have exclusive use and control of the land upon which the holder is located, the holders must be built in all respects in accordance with the code provisions applicable to pipelines to operate under the same pressures and in the same locations. If pipe-type or bottle-type holders are to be installed on land under the exclusive use and control of the owner, and this land is fenced, then some economies can be effected in the design of the holders under certain conditions specified in the code.

Since by definition bottle-type holders are manufactured and tested in the manufacturer's plant, the code permits the use of a steel for bottle-type holders that would not be permitted for pipe-type holders or for pipelines. This steel is a high strength steel which must be welded under carefully controlled conditions and heat treated after welding. The use of bottles made of this steel is permissible, providing all welding is done in the manufacturer's plant, and field welding on holders of this type is prohibited.

Both bottle-type and pipe-type holders are classified in the code as facilities that may, at times, be bottle tight (that is, entirely free from leakage). Consequently, devices to prevent the accidental overpressuring of the holders must conform to the code requirements for pressure-relief devices for bottle-type structures.

• • •

NOW let us proceed to a discussion of Chapter 5 of the code, which deals with operating and maintenance procedures. The question as to whether the code should contain any provisions concerning operating and maintenance procedures was one that received considerable attention. It was observed by Subcommittee 8 that all of the state codes that have been set up thus far, covering gas transmission and distribution facilities, contain requirements pertaining to operating and maintenance. Subcommittee 8 concluded, therefore, that if such provisions were not put into Section 8, the code would be considered incomplete by state and other government agencies, and such agencies would probably, in many cases, consider it necessary to supplement our

code with provisions for operation and maintenance. The committee concluded, therefore, that it would be desirable for it to develop such provisions and include them in the code.

The committee quickly realized that it would be impractical to include in a national code detailed requirements concerning the operation and maintenance of gas transmission and distribution facilities. This is because of the great difference in the present condition of various systems, difference in the materials used in their construction, and different operating conditions. It is obviously possible, however, for each operating company to set up a maintenance program and operating procedures that will be well suited to its particular conditions. The basic requirement of the new code regarding operating and maintenance is perhaps unique insofar as code writing is concerned, but is nevertheless a very practical type of code provision.

The basic requirement as stated by the code is, "Each operating company having gas transmission or distribution facilities within the scope of this code shall: a. Have a plan covering operating and maintenance procedures in accordance with the purpose of this code. b. Operate and maintain its facilities in conformance with this plan. c. Keep records necessary to administer the plan properly. d. Modify the plan from time to time as experience with it dictates and as exposure of the public to the facilities and changes in operating conditions require."

The code goes on to list the type of items that should be included in a maintenance program. However, for the most part these are merely suggestions included for the purpose of developing a picture as to the magnitude and thoroughness of the maintenance program that would be considered by the committee to be adequate. A well worked-out maintenance program and a systematic statement in writing of the program is not only necessary to comply with the code, but it is necessary as a management control device in any company, particularly large companies operating over a wide geographical area. A program that systematizes maintenance work and gives management adequate control over it and that has been developed by the operating company in good faith with the intent of adequately providing for public safety as well as for other objectives that the company wishes to achieve, will put the company in compliance with the code and will provide for a degree of maintenance that will go far toward eliminating any tendency on the part of government officials to try to spell out in detail the amount and extent of maintenance work that a company should do.

Some of the items that should be in the maintenance program, the code says, are:

For Pipelines

a. A patrolling program.

b. Periodic inspections and tests to determine if provisions made for controlling external corrosion are adequate.

c. Periodic inspections or tests to determine the extent of internal corrosion if there is evidence that such is occurring.

d. Corrosion control records, including cathodic protection operating data, records of surveys to determine the effectiveness of cathodic protection, and records of leaks found and leaks repaired.

For Distribution Systems

a. Periodic patrolling of mains where special hazards exist.

b. Systematic leakage surveys, the type and frequency to depend upon local conditions.

c. Procedures that will insure the proper disconnecting and sealing of services for which there is no further planned use.

For Compressor Stations

a. Approved starting, operating, and shutdown procedures that provide for safety.

b. Periodic inspection and testing of relief valves and other automatic safety devices.

c. Inspection for corrosion.

d. Approved procedures for isolating sections of pipe or equipment and purging to prevent explosions or injury during repair or construction operations in an operating station.

For Pressure-Limiting and Pressure-Regulating Stations

a. Periodic inspection and tests to determine that equipment is in good mechanical condition and adequate and set to function at the desired pressure.

For Valves

a. Valves that might be needed in an emergency should be periodically inspected and partially opened or closed to see that they are in good mechanical condition.

For Vaults

a. Periodic inspection and tests to see that they are adequately ventilated.

At this point I may be wandering to some extent from the subject assigned me, but I would nevertheless like to point out that compliance with a safety code is only one and possibly one of the least important benefits that a company can derive from the time and money spent to develop and set down on paper an orderly and effective maintenance program.

Such a program should not only contain step-by-step procedures for performing the operations involved and the frequency with which such operations should be performed, but it should also spell out such things as

1. Who is responsible for the overall program.
2. Who is responsible for the proper performance of each part.
3. The records necessary to guide the progress of the program.
4. The records and reports necessary to make it possible for management to make decisions management should make.
5. Statements of policy and procedures needed so that designated supervisors can make important decisions such as when should a main be replaced rather than repaired, in the manner desired by the management.
6. Follow-up provisions to make sure that instructions are understood and are being followed by those who execute them.

Such a program can be a very effective tool of management and can

1. Make possible the accurate control of the total amount of maintenance expenditures.
2. Make sure that first things are done first.
3. Make sure that the program is economically sound.
4. Make sure that maximum benefit is obtained per dollar spent.
5. Provide statistics that indicate whether the scale of the program is keeping the overall condition of the system the same or is gradually improving it or gradually allowing it to deteriorate.
6. Give comparative cost figures to indicate the relative efficiency of various operating divisions or crews.

The code of course is not concerned with matters of this type. My point is that a basic requirement of the code can be expanded into a program that constitutes complete compliance with the code and, at the same time, puts under management control an important operation which is in many companies actually wasteful and over which management in reality has no effective control in many cases. Or conversely, a company that has taken the steps necessary to put its maintenance work under the management control that it should have, has probably by virtue of this fact already done everything that is necessary to comply with the maintenance provisions of the code. ■

Security principles for the gas utility

Whatever security measures are to be taken against enemy sabotage or direct attack must be put into effect before such an attack — in other words, now. The security program, and hazards to be expected, are outlined in Part I of three parts.

BECAUSE of the vital role that the gas industry plays in defense industry and in American living, it is imperative that a carefully planned security program be instituted to safeguard it against enemy attack or sabotage. The job of establishing and executing such a program lies primarily with the management groups of individual gas companies. Outlined here are the highlights of such a program, general in scope, to be used as a guide for security personnel.

The outline is adapted from a 200-page booklet entitled "Security Principles for the Petroleum and Gas Industries" published by the National Petroleum Council. Information obtained from many pamphlets and reports published by various government agencies is included in the text. The keynote of the entire booklet is that whatever security measures are to be taken must be put into effect before an enemy attack comes—in other words, now. The compilers of the booklet point out that not only the winning of "World War III," but also the prevention of such a war, may depend to a large extent upon effective industrial defense planning.

GAS staff report

Measures and Techniques

Security, as treated in the booklet, includes, but is not limited to, the adoption of measures and techniques to (1) minimize the loss of personnel, premises, processes and products or services due to industrial hazards, epidemics, or catastrophes caused by the elements; (2) prevent espionage and sabotage; (3) provide passive defense against enemy attack, and (4) expedite emergency restoration of productive or service capability in the gas industry in both peace and war.

Security in the gas industry is, in one sense, more critical than in the electric power industry for the reason that gas systems are not interconnected as are power systems, and once a vital link of a gas system is destroyed, gas supplies to all the customers in that area are curtailed. And although we have the natural gas background of World War II as a guide, there is no assurance that conditions in a possible future war would be comparable.

The question arises as to how far a gas company can go, and still stay within the bounds of feasibility, in the way of actual installations of barriers, personnel shelters, fencing, protective lighting, extensive use of guards, etc. This applies to security measures against both sabotage and direct enemy attack.

Management must evaluate its facilities with an eye to *criticality* and to *vulnerability*. The relationship of the relative criticality and the relative vulnerability determines the degree of protection that each part of the system should be provided.

Criticality ratings

Relative criticality ratings should consider the present or potential importance of the military or industrial installations dependent upon the gas supply. The reserve or surplus fuel supplies available to the installation in case

the gas supply is shut off should also be taken into account. Hazards created by interrupted service and replacement time are two other factors of importance.

Size of community

Gas facilities should also be evaluated as to the size of the community and its dependence upon gas, and the proportion and importance of the industrial consumption as compared with the domestic consumption.

Relative vulnerability is determined by many factors. Proximity to concentrations of industry, geographical location, type of building construction, whether installation is above or below ground, and many others contribute to or detract from the facility's chances of surviving an attack. It is not economically feasible for each item in the system to receive the same degree of attention. Because of its day-to-day operation of the facility, management is in the best position to determine the susceptibility of damage to each part of the system, the means by which is can be damaged, and the amount of work necessary to repair it.

It is the duty of management to determine the criticality and the vulnerability of such facilities as pipeline compressor stations, gas regulating stations, distribution systems, research centers, and other facilities as appropriate.

HAZARDS

Damage to gas facilities may be divided into four classifications. First, there are hazards inherent in the production or service operation. Secondly, espionage is an ever present threat to gas facilities. Sabotage presents a real threat to gas company installations in time of war, "hot" or "cold." Fourth, gas installations may be completely destroyed by direct enemy attack.

Production or service operation hazards

A protective program should not be confined to meeting the most hazardous situations. It should be a continuing activity beginning in peacetime and extending to meet the particular hazards of formal hostilities. Increased production to satisfy the needs of national defense emergencies naturally intensifies routine hazards. Specific operation hazards to the gas industry depend on such variables as industrial process, the type of facility, facility layout and construction, the level of the organized protection and prevention program enforced by management, location, topography, etc. Private organizations such as the American Petroleum Institute, American Gas Association, the National Fire Protection Association, and others have issued information pertaining to these hazards.

Espionage

Espionage includes the collection of information that contributes to an evaluation of the nation's war potential and that may be used to advantage by an enemy in subversive activities and armed force attack. The very nature of the gas industry makes it diffijcult to conceal the many phases of its operation.

Espionage agents specifically seek information such as the following:

(1) Capacity, rate of production, industrial mobilization schedules, and details of orders on hand.

(2) Specifications of products.

(3) Test records of newly developed items or equipment.

(4) Sources of raw materials and components.

(5) Destination of completed products and transportation routes.

(6) Data on production methods.

(7) Critical points and possible methods of effective sabotage.

(8) Measures in force for security and to prevent sabotage, such as frequency of inspection by guards and their dependability.

(9) Names of dissatisfied employees and non-employees who might be susceptible to and utilized for subversive plans.

In general, espionage may be rendered ineffective or made more difficult by the application of protective measures such as a careful loyalty check of personnel, particularly before employment; prevention of unauthorized entry to the premises; special guarding and handling of classified material; restriction of movement within the facility; and security education and training of employees and others who have information on the system or facility's activities.

Sabotage

Industrial sabotage is the most effective method that can be applied against a national defense emergency effort. The fact that there was very little damage directly traceable to enemy sabotage during World War II might well be attributed to the lack of ingenuity exercised by the enemy in the direction of sabotage and the selection of sabotage methods, rather than to his failure to appreciate the effectiveness of this form of warfare. Industrial sabotage is a basic doctrine of the Communist party and other revolutionary bodies. The undeniable existence of this doctrine, the highly effective results that may be accomplished by the skillful employment of sabotage, and the known existence of substantial groups within this country available and willing to undertake such work places this hazard higher upon the list of risks confronted by the gas industry than at any time in the history of this country.

In terms of trained manpower, equipment, and munitions risked, a sabotage operation involves only nominal expenditures by the enemy, but the profit may be enormous if the target has been strategically selected. The disastrous consequences of an act of sabotage, such as the destruction of a critical compressor station, would be greatly disproportionate to the manpower, time, or material devoted to the act. It is to be expected, therefore, that the outbreak of a formal attack on this country would be accompanied by one or a series of well planned major sabotage efforts.

The tools and methods of sabotage are limited only by the skill and ingenuity of the saboteur. The methods of sabotage may be generally classified as follows: *mechanical,* which includes breakage, insertion of abrasives and other foreign bodies, failure to lubricate, maintain and repair, and omission of parts; *chemical,* including the insertion or addition of destructive, damaging or polluting chemicals in supplies, raw materials, equipment, product, or utility systems; *explosive,* or damage and destruction by explosive devices or the detonation of explosive raw materials or supplies; *fire* or ordinary means of arson, including the use of incendiary devices ignited by mechanical, chemical, electric, or electronic means; *electric and electronic,* such as interfering with or interrupting power, jamming communications, interfering with electric and electronic processes; *psychological,* including the fomentation of strikes, jurisdictional disputes, boycotts, unrest, and personal animosities, inducing excessive spoilage and

inferior work, causing "slow-down" of operations, provocation of fear or work-stoppage by false alarms, character assassination, and other means.

Physical sabotage is essentially an inside job, or requires the assistance, knowingly or unknowingly, of someone inside. Hence, the principle protective measures must be designed to limit the entry or continued presence of saboteurs or their assistants.

DIRECT ENEMY ATTACK

The responsibility for preventing or minimizing direct enemy attacks rests primarily with the armed forces. Some protective measures may be taken by industrial concerns, however, and an understanding of the types of weapons with which they may be attacked will reduce the number of casualties and amount of damage occurring.

Types of enemy attack may be classified under (a) air attack, (b) chemical attack, (c) biological warfare.

Air attack would probably be the most likely. Regarding this type of attack, it might be said that:

(1) Pipelines, although easily damaged, are quickly replaced or by-passed and, hence, do not materially affect production.

(2) In no case will complete destruction of a pipeline be accomplished, regardless of the weight of the attack or attacks.

(3) Continuity of production or service may be more easily reduced by attacking outside sources of the facility or system such as power, water, etc.

(4) Attack by fragmentation bombs or high pressure systems containing inflammables, followed by an attack of incendiaries, will result in considerable damage.

(5) Trained fire-fighting crews and adequate equipment can materially reduce damage.

(6) Personnel casualties can be held at a minimum by providing personnel shelters.

(7) Blast walls of steel, concrete, or earth may reduce damage to critical equipment from near misses of 500-lb bombs, and smaller bombs.

(8) Smoke screens, camouflage, and decoy plants are only sporadically effective.

(9) Plans should be made for provision of shelters for those who must remain on duty regardless of hazard.

Security principles... Results of heavy high explosive bombing will approximate A-bomb damage

The gas industry must be prepared to provide protective measures to minimize the effects of atomic, high explosive, incendiary, bacteriological or biological, chemical, or radiological attacks. The primary problem in the event of such an attack is to determine which disaster measures are to be undertaken by the system or facility personnel.

Many magazine articles and pamphlets have been written about the probable effects of atomic and hydrogen bomb attacks. Areas of complete destruction, severe damage, and partial damage have been estimated at varying distances from "ground zero" for bombs of different magnitude. Types of underground personnel shelters and protective clothing are discussed at length.

The second type of air attack, using high explosive bombs, produces, on a lesser scale, the same type of blast and fire damage which results from an atomic bombing. A study of bombing results in Europe after the last war indicated that a tremendous weight of bombs was required to destroy completely a factory building. Generally, damage was greater to wall bearing buildings than buildings of steel or reinforced concrete frame construction. Such bombs were, in addition, responsible for destruction fires, particularly where the explosion caused leakage of gases, oils, and other inflammable material. When used in large numbers, the overall effect may be roughly comparable to that of an atomic bomb as far as fire and blast damage is concerned.

Incendiary bombs constitute the third threat from air attack. During the last war, incendiary bombs caused much greater fire damage than did high explosive bombs. In an incendiary attack, fires started concurrently in buildings over a large area, and in mass attack may produce "fire-storms" or "conflagrations."

Guided missiles are the fourth possible means of air attack that a future enemy might employ. The effect of a guided missile attack would be similar to that of a conventional air attack, the nature and degree depending upon the type of warhead used and the number of missiles the enemy is capable of delivering.

Chemical warfare

Besides attack by air, the enemy could inflict great damage on this country by means of a chemical warfare attack. It is probable that the enemy has stocks of toxic gases and means of delivering them in effective quantities. Of greatest concern are the nerve and blister gases which are persistent. Persistent gases are more likely to be used by the enemy in industrial areas because they are more lethal and make the area untenable for some time.

Biological warfare might also be employed in a future war. This is the use of disease germs for the purpose of decreasing an opposite force's ability to wage war. The following facts are pertinent:

(1) A determined and resourceful enemy could employ the agents of biological warfare against us with possible devastating effect.

(2) Such agents might be disseminated by saboteurs before or after open war, or as part of an overt attack.

(3) Biological warfare could be directed against humans, animals, food, and industrial crops.

(4) An enemy with a reasonably modern, scientific establishment can produce effective agents in adequate quantities.

(5) Agents capable of being used for biological warfare may be imported surreptitiously, or they may be produced within the United States by workers in clandestine laboratories. ■

Next Month

In Part II, specific protective measures are discussed. A few of the security aspects examined are personnel screening and education, access control, and safeguarding classified matter.

Caloric

teams up with

Arlene Francis

on the big **NBC-TV**

network show

HOME

right through the heart of your best selling season!

Yes, it's the most spectacular advertising and promotion campaign in the entire gas range industry

Coast-to-coast television! A popular show! An exciting TV personality! This powerful advertising combination will be selling Caloric Ranges this fall. Yes, every Wednesday, beginning September 21st and continuing for 8 full weeks through November 9th, Caloric gas ranges will be shown and demonstrated by ARLENE FRANCIS herself on her famous HOME show. Over two million interested housewives in major U.S. cities will be at their television sets, watching every move, hearing every word. It's the most exciting and comprehensive promotion Caloric has ever undertaken. It's designed to offer you powerful support throughout the whole fall season, to help you sell MORE Caloric ranges in Fall, 1955.

Quick action traces water heater dip tube trouble, leads to revised requirements

A "MEDICINAL" odor and taste detected in water drawn from several new water heaters equipped with plastic dip tubes has been traced to its origin—a batch of impure plastic resin.

Rigid test standards have been set up by gas water heater manufacturers, the AGA and suppliers of plastic tubing to prevent a recurrence.

A report issued by the water heater approval requirements subcommittee of the AGA, after exhaustive investigations of scattered consumer complaints in various sections of the country, said:

"It has been determined that the odor and taste problem arose from an undetected, unsatisfactory batch of basic plastic resin produced and shipped, approximately in June 1954, to two or more tubing extruders. So far as can be determined, all cases of 'medicinal odor' have arisen from this one batch. Investigation indicates that no toxic effect was produced, and that after two weeks' operation of the heater the water was no longer affected. Preventive action has already been taken on this score."

Complaints from purchasers that water heated in several new heaters had a taste and odor resembling that of iodine or chloride were received by dealers and manufacturers. As a result of the complaints, two cities —Chicago and Atlanta—took steps to ban plastic dip tubes. It was reported that the ban in Atlanta was ordered on the basis of reports of only two faulty dip tubes.

Polyvinylchloride dip tubes are being used widely in new water heaters because they eliminate the electrolytic corrosion problem frequently encountered when metal tubes are used.

When the consumer complaints reached manufacturers, they were channeled to the association's testing laboratories.

Detailed tests were made on samples of suspected plastic dip tubes. From these tests, the AGA established that the odor and taste found in the new heaters owned by the complainants resulted from the presence of impure resin in the polyvinylchloride. The AGA was able to set up new proposed requirements for plastic dip tubes—requirements that now are being generally accepted by all manufacturers. These proposed requirements are:

1. Non-metallic dip tubes shall be accompanied by evidence acceptable to the testing agency that the material is suitable for the service, particularly with respect to toxicity, solubility, brittleness, temperature limits, etc.

2. Each non-metallic dip tube shall be permanently marked with the manufacturer's name or trade-mark and, if possible, the lot number.

Warning tag

3. Each water heater incorporating a plastic dip tube shall bear a warning tag attached to cold water inlet of the heater stating: "Do not apply heat to this fitting when making sweat connections to heater. Sweat tubing to adapter to cold water inlet of heater. It is imperative that no heat be applied to the cold water inlet as it contains a plastic dip tube."

4. Non-metallic dip tubes shall have a linear deformation not in excess of ½ in., a total lateral deformation not in excess of 1½ in., and shall undergo no weight loss when tested under the following conditions: 12 samples of each lot of dip tubes, cut to the same length, shall be submitted. The length and weight of each tube shall be determined and recorded. The samples shall then be cooled to room temperature, surface water removed, and the length and weight determined and compared with the original results. Any weight loss shall be considered as evidence of failure.

5. Non-metallic dip tubes shall not impart odor, taste or color to water.

Method of test

Four 1-in. lengths of sample tubes from each lot of non-metallic dip tubes shall be placed in each of two 500-ml Erhlenmeyer flasks, with 250 ml distilled water to one flask and 250 ml of tap water to the other. Close each flask with a metal stopper provided with a small vent hole. Maintain both flasks at 170° F for 24 hours. At the end of the 24-hour period, remove flasks from heat source, cool to convenient handling temperature and immediately check for odor and taste. Remove tube sections from flasks and examine water for color. At least two observers shall independently check each flask for odor and color.

A "strength" test will be included as soon as details are developed.

The proposed test requirements already have been adopted by numerous manufacturers. In addition, L. T. Tegler, chairman of the manufacturer members of the AGA water heater subcommittee, recommended a three-way certification plan as follows: resin manufacturers are to certify that they will furnish to the extruder pure polyvinylchloride, the extruder is to certify that he will use nothing but such virgin resin in his extrusion operation, and water heater manufacturers may certify that they will purchase only from extruders using virgin (not reclaimed) material.

The water heater subcommittee reported that complaints of dip tubes dropping out of position result from soldering copper water tube to fittings in place on the heater during installation. Water heater manufacturers are now generally advising installers relative to the correct method to avoid such damage.

GAS associations——

Standards conference set for Washington, D. C.

Government and industry leaders will join forces in a public discussion of their relative roles in standardization at the sixth national conference on standards in Washington, D. C., Oct. 24-26. Subjects will range from the legal implications of standardization to the coordination of Defense Department and industry requirements for manufactured products.

The National Bureau of Standards and the American Standards Association are co-sponsoring the three-day conference, which will be held at the Sheraton-Park hotel.

One of the sessions during the conference will be devoted to a series of speakers who will discuss the relationship of industry standards and those of the General Services Administration. The industry side will be represented by Lester W. Benoit, secretary, Manufacturers Standardization Society of the Valve and Fittings Industry, and a spokesman from the American Society for Testing Materials.

Contractors 1956 meeting set for Florida in January

The Pipe Line Contractors Association will hold its 8th annual convention at the Boca Raton hotel and club, Boca Raton, Fla., Jan. 16-18, 1956, according to an announcement made by H. C. Price of Bartlesville, Okla., president of the association.

It is expected that approximately 600 representatives of the pipeline construction industry will attend the convention next January.

Hotel reservations will be handled through a housing committee, and further announcements concerning such reservations will be made later. Additional information regarding the convention may be obtained through the executive secretary of the association, Richard A. Gump, 2232 Republic National Bank Bldg., Dallas.

Research plant to be toured by CNGA members

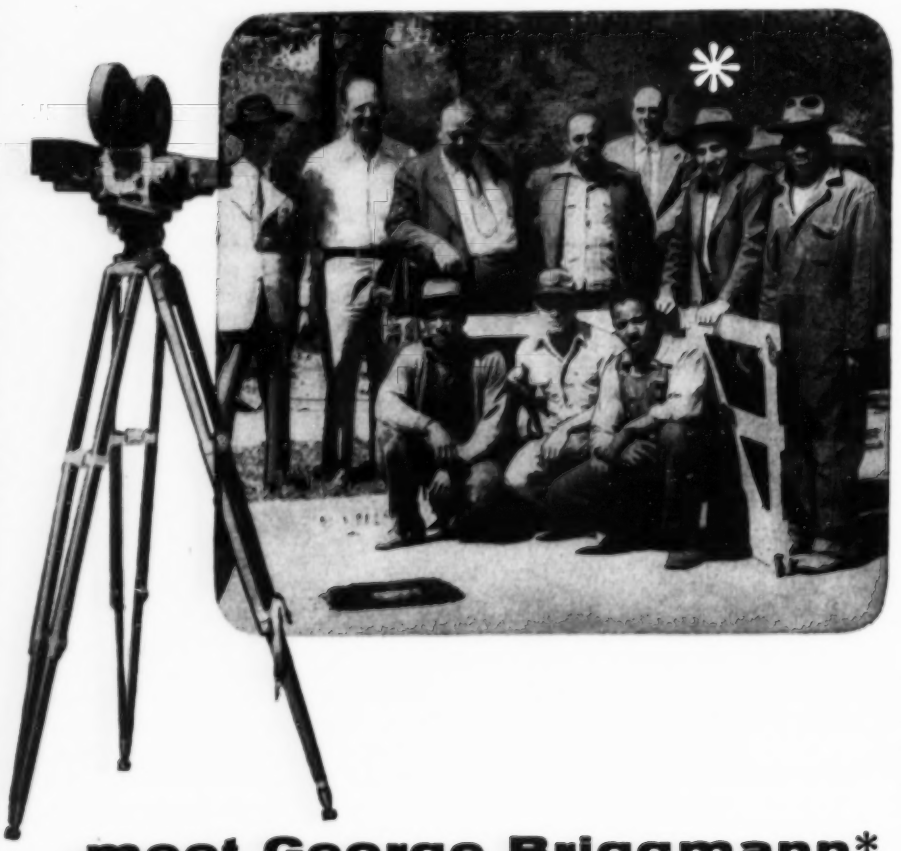
Oct. 13-14 are the dates of the 30th annual fall meeting of the California Natural Gasoline Association. Meeting place is the Ambassador hotel in Los Angeles.

A first day of technical forums will present panel discussions on many of the latest testing methods, maintenance procedures, plant installations, and corrosion problems. The second day will include a conducted tour through the Brea Research facilities of the Union Oil Co. of California and a general meeting, at which time some of the outstanding men of the industry will speak.

GAMA forms new division; announces new members

The board of directors of GAMA has announced the formation of a new division—the gas unit heater and duct furnace division. Heading the division as chairman is David R. Webster, president of Reznor Manufacturing Co. On assuming the office, he automatically becomes a member of the board of GAMA.

The association has also announced the election of Trageser Copper Works Inc., Maspeth, Long Island, N. Y., to



meet George Briggmann*

. . . a member of CARBIDE's CARBOSEAL *Anti-Leak staff*—with a gas crew and a camera crew, shooting scenes for the movie "CARBOSEAL Anti-Leak Stops Gas-Main Leakage." In 15 minutes, this film shows you the ease, economy, and effectiveness of CARBOSEAL Anti-Leak in stopping leakage due to dried-out fiber packing.

There's a lot of George's valuable experience in this 16 mm. color-sound film. And we'll be glad to lend it to you—just write to:

CARBOSEAL ANTI-LEAK

Carbide and Carbon Chemicals Company
A Division of Union Carbide and Carbon Corporation
30 East 42nd Street UCC New York 17, N. Y.
In Canada:
Union Carbide Canada Limited, Toronto

"Carboseal" is a registered trade-mark of Union Carbide and Carbon Corporation.

Question:

What will sell MORE gas ranges at HIGHER profits?

Answer:

Robertshaw® TIMER controls!

How do we know?

Because the WOMEN of America say so. Through an independent research organization, Daniel Starch and Staff, women in every walk of life were asked about their attitudes toward Potwatcher and Temp 'n Time controls.

THE RESULT: WOMEN WANT THEM! 9 out of 10 women want *both* controls. 6 out of 10 say that these controls make other ranges obsolete. 6 out of 10 say they would buy a new range *sooner* if equipped with *either* of these controls.

AND... women value the convenience and performance so highly that *they would expect to pay $15 to $25 MORE* for a range so equipped.

YOUR OPPORTUNITY: Win new customers faster by featuring ranges equipped with Potwatcher and Temp 'n Time automatic controls. Women *want* automatic controls, want the advantages of cooking with them, *and are willing to pay extra to get them.*

WE'LL PROMOTE THEM—YOU CASH IN. National advertising, dealer helps, salesman's helps, demonstration material, newspaper mats, point of sale, radio spots, and merchandising ideas... to help you get the lion's share of range sale profits!

WRITE TODAY... for sales sake!... for list of manufacturers featuring these controls on their Gas Ranges.

Mr. Controls®

Robertshaw-Fulton CONTROLS COMPANY

Robertshaw Thermostat Division, Youngwood, Pennsylvania
Robertshaw-Fulton Controls (Canada) Ltd., Toronto

Select the controls that help you sell-

associations • *Continued*

membership in the gas water heater division. Other new members are San Gabriel (Calif.) Boiler Manufacturing Co.; Gross Furnace Manufacturing Co., Salem, Va.; and Major Metal Products Inc., Los Angeles.

Wendell C. Davis, president of Cribben & Sexton Co., Chicago, has been appointed vice chairman of the domestic gas range division, filling the unexpired term of Fred A. Kaiser, who resigned recently.

GAS association notes

J. F. Dempsey, director of public relations for Peoples Water & Gas Co., North Miami, Fla., has resigned his position there to assume new duties with the American Gas Association. He will work with the promotion department of AGA and be on hand to assist any utility in setting up its state contests for "Mrs. America."

The annual commercial sales roundtable conference of the Southern Gas Association was held recently at the Tutwiler hotel in Birmingham, Ala. Nineteen delegates representing 13 companies were in attendance at the meeting. The conference was chairmanned by B. G. Bell, Alabama Gas Corp. The agenda included such topics as steps being taken to meet electric fryer competition, commercial sales promotion, summer water heating load, absorption air conditioning, and services rendered to commercial customers.

GAS current reading

MANAGEMENT PLANNING AND CONTROL — Reflecting management's growing interest in long-range planning, the Controllership Foundation Inc. has issued this indexed and annotated bibliography, listing 721 separate books, monographs, and magazine articles on management problems.

The breakdown of the book is as follows: basic and general; organization for management planning and control; establishing the goals of the business; forecasting and related analyses; planning and related research and analysis; budgeting and control of assets, expenses, and operations; reporting results and appraising performance.

An alphabetical index of publications and one of the publishers of books listed are included.

Additional information is available from the foundation's headquarters, 1 E. 42nd St., New York 17. Price: $5 to members of the Controllers Institute, $6.50 to all others.

EVERYTHING *AND* THE KITCHEN SINK—This 160-page, generously illustrated book tells how, during just one century, American industry has completely revolutionized the life and hopes of America by constantly seeking for better ways to do things.

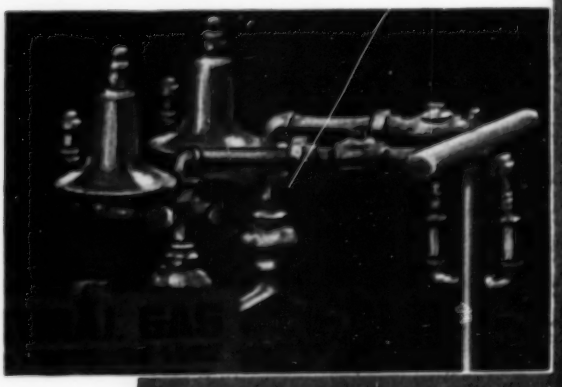
The book, which commemorates the centennial of Crane Co., Chicago, is published by Farrar, Straus & Cudahy.

Correction

During production of the August issue of GAS, a byline was inadvertently dropped from the article, "How to give a meter a double-quick dunking," beginning on page 58.

In order to give credit where it is overdue, and to clear up any confusion that may have risen as to locale of the article, the author's name and affiliation follow: Steven J. Harrison, superintendent, gas meter department, New Bedford (Mass.) Edison Light Co.

A WIDER RANGE
... of Delivery Pressure Control



REYNOLDS HIGH PRESSURE LINE REGULATORS

in parallel hookup have an increased range of capacity as well as a wider range of delivery pressure control. This also provides greater margin for emergencies. On inlet pressure the range is up to 650 pounds. For outlet pressure, this unit assures absolutely accurate and dependable control from 2 to 100 pounds. This variance in outlet pressure is made by use of different sizes of diaphram cases and further flexibility in the spring type is possible by use of different strength springs.

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423 Dwight Building
Kansas City, Missouri

SEIDENGLANZ & CO.
2nd Unit, Santa Fe Building
Dallas, Texas

REPRESENTATIVES

EASTERN APPLIANCE COMPANY
Boston, Massachusetts

WALDO S. HULL
163 W. Queen Lane
Philadelphia, Pennsylvania

Reynolds Gas Regulator Co.
ANDERSON, INDIANA, U. S. A.

GAS CONTROL SINCE 1892

to sell 'em
...you've got to tell 'em!

EMPIRE

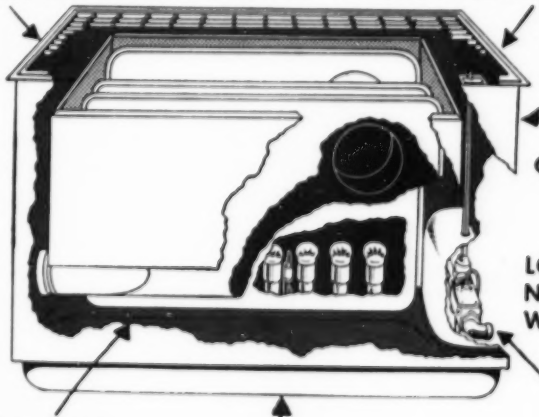
MAKES THE BEST *Gas* HEATING APPLIANCES IN THE WORLD

There's* NO DOUBT *about it!

AMERICAN GAS ASSOCIATION — TESTED WITH NATIONAL SAFETY REQUIREMENTS — APPROVED

MEMBER
national LP-GAS PROMOTIONAL program

88% Open Registers — More Air Travel — More Heat!
NO FIRE HAZZARD! NO FUMES . . HEALTHFUL HEAT!



OUTER CASING RUST RESISTANT

LONG LIFE . . . NO BURN-OUT EVEN WITH CONTINUED USE!

CLEANS QUICK AND EASY

NO LOUD TICKING . . NO BOOM NO BANG

CONTROLS ACCESSIBLE . SAFE FROM DAMAGE!

Clean... Quick... Comfort* FOR A *Lifetime

Empire a great name in Gas Appliances

See your distributor or write direct to EMPIRE today.

EMPIRE STOVE COMPANY
BELLEVILLE, ILLINOIS

GAS people

Promotions

Pacific Gas & Electric Co., San Francisco, has elected SHERMER L. SIBLEY and ROBERT R. GROS to vice presidencies. In addition, Mr. Sibley was named assistant general manager of the company. Mr. Gros will devote his time to informational activities and special assignments by the president. A. JAMES MCCOLLUM succeeds Mr. Gros as manager of advertising and publicity.

BERNARD H. WITTMANN, assistant vice president in charges of sales, has been elected vice president in charge of sales for the Peoples Gas Light & Coke Co., Chicago, succeeding FRANCIS X. METTENET, who retired early this month. Prior to joining Peoples Gas in 1935, Mr. Mettenet was general sales manager of Public Service Co. of Indiana.

HOWARD A. PRAEGER, who has been assistant advertising manager, has been promoted to sales manager of New York State Electric & Gas Corp., Binghamton, N. Y.

MARTIN G. RAAKE and HASCAL SIMMONS, formerly zone managers for the Coleman Co. Inc., Wichita, have been appointed national field sales managers of the heating and air conditioning division of the company.

R. G. HUNTER, manager of the Tulsa branch of Crane Co., has been named district manager with headquarters in Dallas. He succeeds J. A. MCMURRY who has been named director of Crane branches with headquarters in Chicago.

H. Zinder & Associates Inc. has named EARL A. TRAGER chief geologist, THOMAS L. KISTER senior geologist, and JOHN D. MULLINS senior petroleum engineer.

JAMES F. BELL, who has been a vice president and director, has been advanced to the post of executive vice president of Portland (Ore.) Gas & Coke Co.

W. D. Betsch **I. L. Briscoe**
Ohio Fuel Gas Co.

Several promotions have been announced by Ohio Fuel Gas Co., Columbus. WALTER D. BETSCH succeeds JAMES A. SCANLON as vice president in charges of rates; I. L. BRISCOE is manager of the rate department; J. C. DIDWAY is general representative; and RICHARD C. HARDER is Columbus district special representative.

J. C. Didway **R. C. Harder**
Ohio Fuel Gas Co.

EVERETT A. TAYLOR, who is general sales manager, has been named vice president of Providence (R. I.) Gas Co., succeeding JESSE L. JOHNSON, who has retired. FRANK J. MCLAUGHLIN

No Stooping!

Our Canadian Distributors:
CANADIAN BRASS CO., LTD.
GALT, ONTARIO
CANADA

FRANCIS HAWKIN CO., LTD.
2028 UNION AVE.
MONTREAL, CANADA

"...no needle nervousness...pinpoint accuracy.

THE NEW AQUA VALVE BOX LOCATOR

has our unqualified approval!"

W. F. Becker, Chief Inspector
The Ohio Fuel Gas Company
Columbus, Ohio

Quicker, Surer Locations Every Time

The miraculous new Aqua Valve Box Locator makes obsolete all previous types. New design, perfected after two years of engineering research means **absolute minimum of needle spinning action.**

The new Aqua Extra Conductor development makes failure practically impossible, and it is **exclusive in the location instrument field!**

- New exclusive "Electric Braking" action
- Top-view reading. No stooping.
- Factory adjusted to your geographical location
- New high impact Styron plastic case virtually indestructible
- Compact, convenient, non-variable
- Guaranteed to function regardless of ground cover

$29.50
f.o.b. Cincinnati
Your Name in Gold Free

FREE 15 DAY TRIAL

No Money! No Obligation! You be the judge.

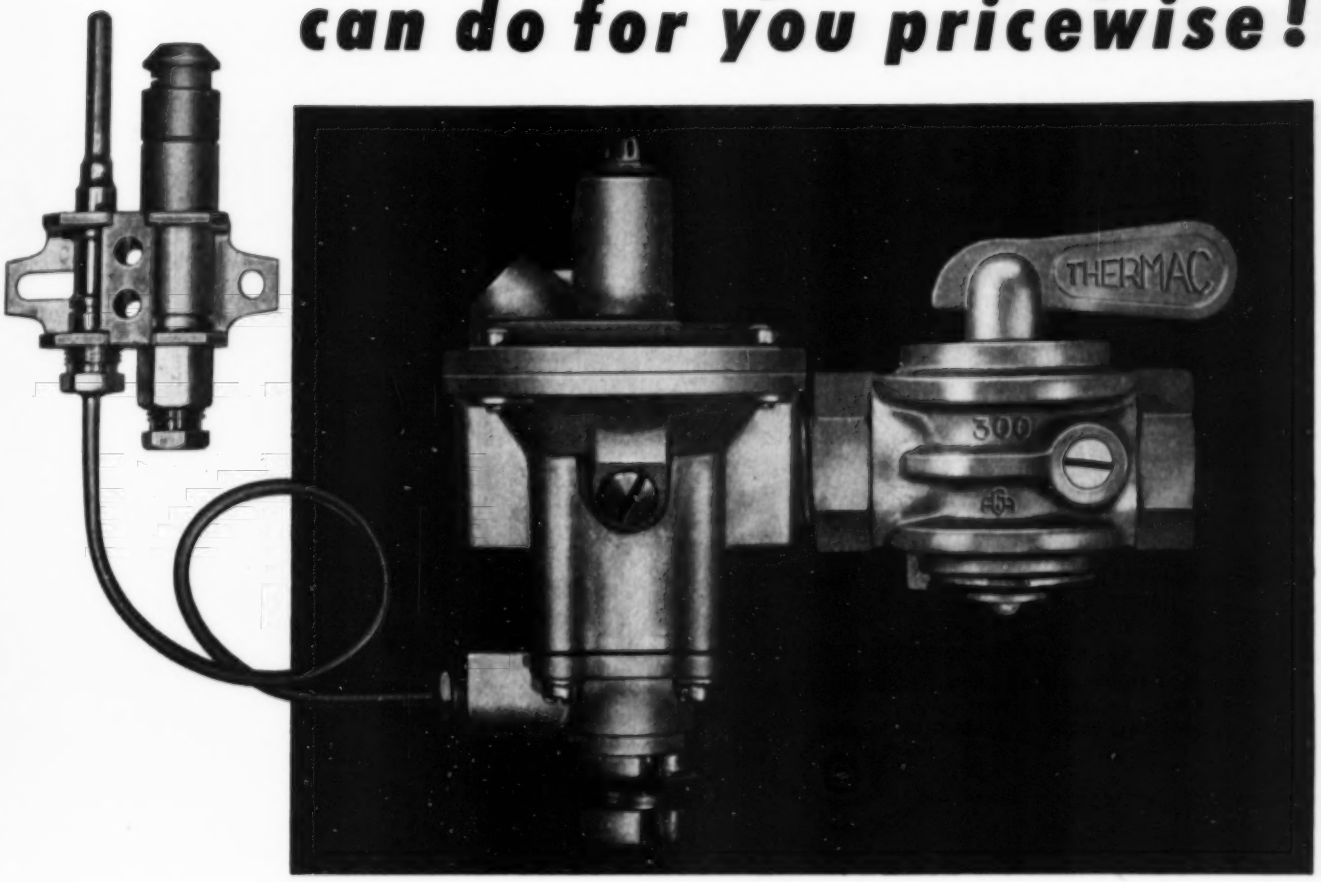
AQUA SURVEY & INSTRUMENT CO.
2016 Worth Avenue Norwood, Ohio

Mail this Coupon for FREE Trial or Literature

Gentlemen: Please send me
☐ New Aqua Valve Box Locator for FREE 15 day professional trial, without obligation.
☐ Detailed literature on new Aqua Valve Box Locator.

NAME.....
COMPANY.....
STREET.....
CITY.....ZONE.....STATE.....

look what THERMAC can do for you pricewise!



In today's big "squeeze" between higher operating costs and lower prices the heating equipment manufacturer eyes carefully the substantial savings offered by Thermac.

For example, use of the Thermac Regulator and Safety Pilot eliminates the expense of an electric re-lay or separate automatic pilot. Then, if the Regulator is assembled to the Thermac free flow aluminum alloy shut-off valve, increased line capacity is attained which frequently means that smaller manifolds and smaller, less expensive auxiliary controls can be used. Together with Thermac's favorable pricing on Regulators and Valves the accumulated saving can easily run into a number of dollars per appliance.

Equally important are the excellent performance, quality of product and immediate delivery offered by Thermac. Our Engineering services are available to you. Simply tell us your BTU requirements and our engineers will gladly advise how Thermac controls can help you and to what extent.

SERVICE IS OUR BUSINESS — ON THE SPOT ENGINEERING ASSISTANCE AND IMMEDIATE DELIVERY.

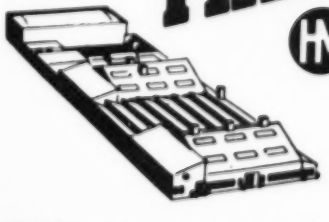
THERMAC

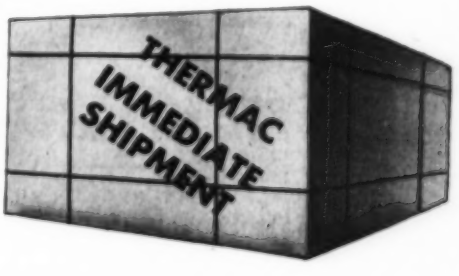
HM COMPANY

800 EAST 108TH STREET

LOS ANGELES 59, CALIFORNIA

Certified by A.G.A.





JR., formerly general sales manager of the Haverhill Gas Light Co., is residential sales manager.

ERNEST P. FRY has been placed in charge of maintenance of Ohio Fuel Gas Co.'s 1600-unit motor transport fleet.

JOHN HORN, who hase been representative for Phillips Petroleum Co.'s natural gas department in Houston, has been promoted to technical advisor to the department management in Bartlesville. He succeeds ALLEN B. HIATT, resigned. J. W. MIMS succeeds Mr. Horn in Houston.

ROBERT D. PUTNAM has been made a vice president of Florence Stove Co., Chicago. In his new capacity he will be in charge of sales of both the Florence Range and the Quaker Heating divisions. At the same time, P. COSTOMIRIS was named sales manager of Quaker Heating.

Several promotions have been announced by Servel Inc. FORREST STRETMATER is chief metallurgist; BURTON BROWN is assistant manager of the credit and collection department; HOMER HARRISON's tasks as budget director have been broadened to include the time keeping and tabulating departments; and JAMES L. PARKER is product manager of household refrigerators.

W. W. Wolfe
American Cast Iron

N. H. Gellert Jr.
Spokane Gas

WARREN W. WOLFE has been made manager of the Chicago sales office of American Cast Iron Pipe Co., Birmingham, Ala., succeeding EARL N. MATTSON, who has retired.

NATHAN H. GELLERT JR., vice president in charge of distribution for Seattle (Wash.) Gas Co., became president of Spokane Gas & Fuel on Sept. 1, succeeding FRANK A. WOODWORTH, who has retired. Mr. Woodworth will remain active in the company as a director and consultant.

J. P. Wiseman

J. G. Bounds
Fluor Corp.

J. P. WISEMAN, president of the Fluor Corp. of Canada Ltd. for the past two and a half years, has been named to head a newly established products company of Fluor. J. G. BOUNDS succeeds Mr. Wiseman as head of the Canadian affiliate of the Los Angeles firm.

LEO M. BROWN has been promoted to the position of manager of the Chicago direct factory sales branch of Gar Wood Industries Inc., Wayne, Mich.

Connecticut Light & Power Co. has announced the following promotions: ANTHONY E. WALLACE to director of public information; GEORGE H. HANEL to manager of the advertising and

Question to management...

What is the real worth of Cathodic Protection?

The real worth of cathodic protection depends primarily upon its effectiveness after it is installed. Inadequately designed or improperly installed systems will not do the job. Savings on your corrosion control costs can best be obtained with experienced E. R. P. corrosion engineers working with your staff.

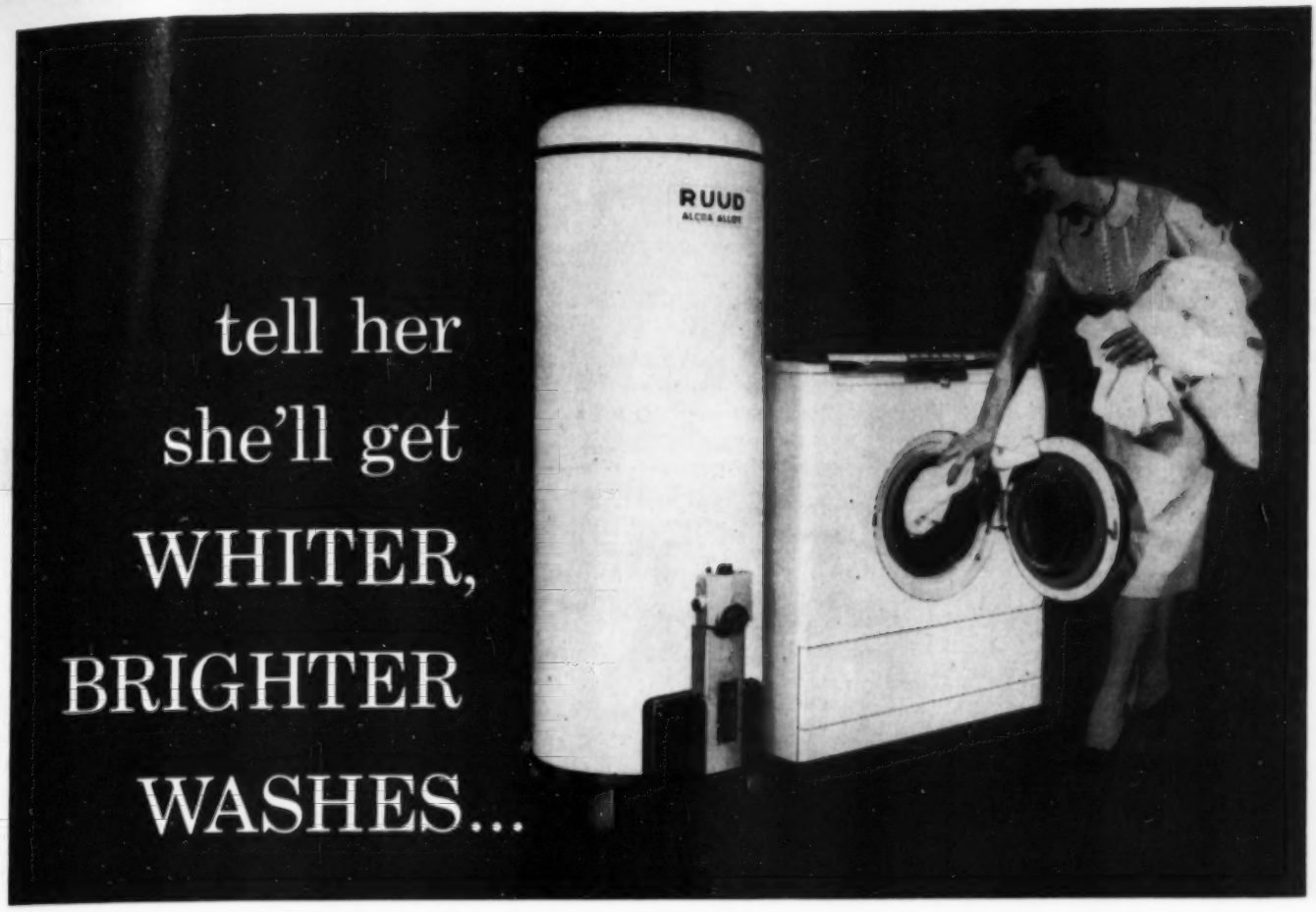
Successful cathodic protection requires careful investigation and correct interpretation of all factors affecting the corrosion of any buried or submerged structure. When you use Electro Rust-Proofing cathodic protection services, you are assured of a successful installation, for E. R. P. brings to each job a background of 20 years experience in survey, design and installation of cathodic protection systems.

Your inquiry—written now—will bring our engineers to discuss your corrosion control program—without obligation.

ERP CATHODIC PROTECTION

ELECTRO RUST-PROOFING CORPORATION
30 MAIN STREET, BELLEVILLE 9, N. J.
ATLANTA CHICAGO DALLAS MONROVIA SEATTLE

E-31



with the water heater that's made for her washer...

RUUD *Laundry Rated* ALCOA® ALLOY!

Here's your opportunity to profit from the one big laundry problem your customers face. Too many of them don't realize that ordinary water heaters are not made to meet the extra hot water demands of modern automatic washers.

Now you can assure them that the Ruud Laundry Rated Alcoa Alloy *is* made to meet these demands, and then some. It supplies *enough* hot water, *hot* enough and *fast* enough for *any* automatic washer . . . and whiter, brighter, cleaner washes.

AND SHE GETS ALL THIS WITH THE RUUD ALCOA ALLOY

- *Sparkling-clean hot water, free of red rust.* The solid aluminum alloy tank is absolutely red-rust-proof!
- *More hot water, faster,* than with ordinary water heaters. Uses GAS, the fast economy fuel.
- *Moderate price* . . . comparable to ordinary lined-steel-tank types. Gives perfect service for many trouble-free years.
- *Two-temperature convenience!* Optional Ruud duo-temp feature delivers *two* temperatures from the same tank at the same time: 180° extra-hot water to serve automatic washers; 125° tap-safe water for bath, shower and lavatory.
- *Recognized quality*—created by two leaders in their fields, RUUD and ALCOA. First and only water heater with tank of solid Alcoa aluminum alloy.

Plumbing contractors and gas companies from coast to coast are capitalizing on the growing popularity of this exceptional automatic gas water heater. Why don't you?

® Aluminum Co. of America

MAIL THIS COUPON TODAY

Ruud Gas Water Heaters
Kalamazoo, Michigan • Toronto, Ontario

RUUD MANUFACTURING COMPANY
Dept. 9-29, 2025 Factory St., Kalamazoo 24F, Mich.

☐ Please have a water heating specialist call on me
☐ Send me literature

NAME _____ TITLE _____

BUSINESS NAME _____

STREET _____

CITY _____ STATE _____

people • *Continued*

publicity department; PAUL L. MORAN to manager of the company's Bristol district, succeeding JOHN P. HANNON, who has retired, and ROBERT E. MILLER JR. to district engineer at Danielson.

PAUL C. KOECHEL has been promoted to the newly created position of supervisor of public relations at Equitable Gas Co., Pittsburgh.

E. S. LARSON, manager of the Joplin, Mo., division of the Gas Service Co. since 1941, has been named manager of the company's property in Kansas City, Kan.

CHARLES C. INGRAM JR., district superintendent of the Oklahoma City district of the Oklahoma Natural Gas Co., has been elected vice president of the land and geological department.

New faces

CLARK J. HAWES has joined James-Pond-Clark, Pasadena, Calif., as direct factory sales engineer for the Philadelphia territory.

GEN. CHARLES L. BOLTE, U.S. Army (Ret.), has joined ACF Industries Inc., New York, as special assistant to the chairman of the board.

DR. JAMES SCOTT LONG has joined Keeler & Long Inc., Waterbury, Conn. Dr. Long will direct development and advancement in the field of corrosion prevention for the paint and varnish manufacturer.

HAROLD LYNN has joined the Parkdale Co., Los Angeles, as general sales manager.

HOMER R. ROSS has joined Southern Counties Gas Co., Los Angeles, as rate engineer.

C. WILLIAM WRIGHT has joined Detroit Controls Corp. as territorial representative in the east central regional office in Cleveland.

JAMES A. BRAMBLETT has joined Laclede Gas Co., St. Louis, as assistant to the operating vice president.

Retired

NILS T. STELLMAN, who joined the company in 1913, has retired from Consolidated Edison Co. of New York as assistant vice president of sales.

WILLIAM LAVERTY, who joined Cambridge (Mass.) Gas Light Co. in 1909, has retired as superintendent of distribution.

H. BRUCE ANDERSON, engineer of distribution, retired recently after 48 years of continuous service with Philadelphia Gas Works.

ROBERT E. BORDEN has resigned as director of the LP-Gas Information Service and secretary of the National Council for LP-Gas Promotion.

Deaths

CLARENCE H. WARING, 73, manager of the Kansas City, Kan., division of the Gas Service Co. and a member of the board of directors, died suddenly on July 18.

JOHN H. COLLIER, 70, former president and chairman of the board of Crane Co., Chicago, died late in July at his home in Fairfield, Conn. Mr. Collier was president of Crane from 1941 to 1946 and served as chairman of the board from 1946 until Jan. 31, 1951.

"I got the idea from Standard Magnesium's VIBRA-PAK Anodes . . ."

We're not so sure it's cricket to carry your own sod on the golf course. But there ARE times when carrying your own soil can mean quite a saving in time, trouble and expense. That's why every VIBRA-PAK Anode is delivered to you already compacted and centered in backfill, ready to drop in the hole. You get BETTER positioning . . . EASIER installation . . . FASTER installation, every time.

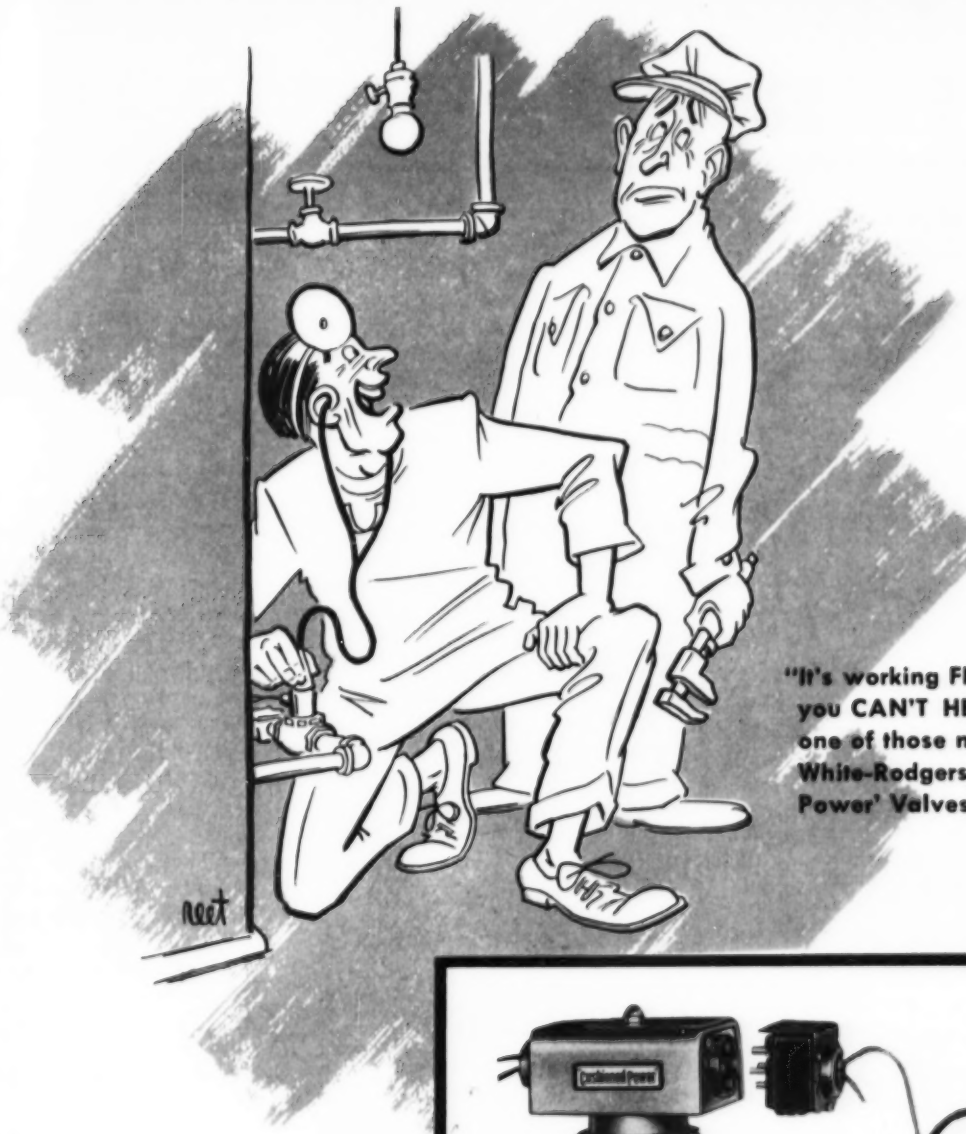
There are several other good reasons for specifying Standard Magnesium VIBRA-PAK Anodes, too. The patented spiral core, for example . . . which really stays put; won't separate from the anode. And, of course, the best reason of all; the magnesium in each VIBRA-PAK Anode is spectrographically analyzed to assure you of *greater purity* . . . more current per pound.

Next time the job calls for dependable Magnesium Anodes to aid in controlling corrosion, specify VIBRA-PAK . . . the "pre-packaged" Anode that carries *it's own backfill.*

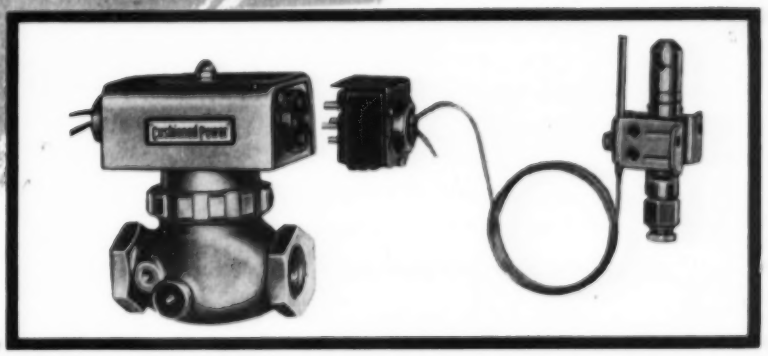
For further information, please address all inquiries to P. O. Box 1424-G, Tulsa, Oklahoma

Standard Magnesium Corporation
TULSA, OKLAHOMA

Pioneers of: SPECTROGRAPHICALLY ANALYZED ANODES AND CYLINDRICAL ANODES



"It's working FINE! Of course, you CAN'T HEAR it. It's one of those new, quiet White-Rodgers 'Cushioned Power' Valves."



in modern gas heating...

QUIETNESS Means Quality!

You can eliminate annoying solenoid "clank" and "snap" with a modern, White-Rodgers "Cushioned Power" solenoid gas valve. It costs no more to add this extra selling feature to your product.

EASY INSTALLATION Saves You Money!

This ingenious "Plug-In" Valve-Pilot Combination is a W-R exclusive specially designed to simplify installation and wiring. The pilot combines a powerful mercury-actuated element with a rugged snap-action switch for positive reliability.

For gas heating controls that assure complete customer satisfaction . . . specify White-Rodgers.

WHITE-RODGERS *Controls*

FOR HEATING • REFRIGERATION • AIR CONDITIONING

ST. LOUIS 6, MO. • TORONTO 8, ONTARIO

GAS news

Ammonia plant planned for Pacific Northwest

Formation of Phillips Pacific Chemical Co., which will construct an ammonia fertilizer plant in southeastern Washington, has been announced by K. S. Adams, chairman of Phillips Petroleum Co., and Ray C. Fish, chairman of Pacific Northwest Pipeline Corp., which companies will jointly own the newly formed company.

The initial unit of the new plant will produce 200 tons daily of anhydrous ammonia to serve growing fertilizer demands in the intermountain, inland empire and Pacific Northwest region. Phillips Pacific has made arrangements with Pacific Northwest Pipeline for a natural gas supply of 15 MMcf/day for use as the raw material for ammonia manufacture in the first unit of the new plant. The plant will be designed by Phillips Chemical Co. and constructed by the Fish Engineering Corp. It is anticipated that the plant will be placed in operation late in 1956, which will enable supplying distributors in the area with fertilizer needed for the spring season of 1957.

PSC ruling on utility sale of stock upheld by court

The court of appeals of Maryland has held that a public utility does not have the right to issue common stock to executive employees under a restricted stock option incentive plan without the approval of the Maryland commission.

The Baltimore Transit Co. had petitioned the commission for approval to issue 60,000 shares of the company's common stock to certain executive employees, under a restricted stock option incentive plan.

The Maryland commission, after a hearing, dismissed the application, stating that (1) the purpose for the issue of the stock did not come within the provisions of the Maryland statute, and (2) even if such purpose were included in the Maryland statute, the commission would not grant the authority on the grounds of public policy. The company took an appeal in the case, and the lower court held that, even though the purpose for the issuance of the stock is not within the purview of the Maryland statute, nevertheless the company had the right to issue the shares of stock under the general corporation law, and without commission approval. The Maryland commission took an appeal from this decision to the court of appeals of Maryland. The court of appeals stated in part:

"It is our opinion that the Baltimore Transit Co. has no right to issue any securities without the approval of the commission. We are also of the opinion that the commission can approve the issuance of securities only for the purposes mentioned in (the statute). . . .

"We hold that if the commission in the instant case meant that it lacks the power to approve any stock option plan, such decision is incorrect, because it is possible that there could be such a plan that would be for the improvement or maintenance of the company's service and in the public interest. On the other hand, if the commission disapproved of the particular plan for the reason that it would not be for the improvement or maintenance of the company's service and not in the public interest, then the court would be incorrect in setting the finding aside. As

PEERLESS MFG. CO. DALLAS TEXAS

PEERLESS
Type "MP"
ODORIZER UNIT
WITH SILLERS
FLEX RING CLOSURE

The Peerless Type "MP" Odorization Unit has been designed to provide a complete odorization setup which is easily installed. This odorizer utilizes the Patented Peerless principle of liquid odorant injection.

LOOK AT THESE ADVANTAGES . . .

- ★ Accurate proportioning of odorant into line.
- ★ Safety tank built in. Cannot flood
- ★ Leakage is eliminated since all welded piping and packless valves are used.
- ★ It occupies a minimum of space. Only one foundation needed.
- ★ A minimum of piping is required for installation.
- ★ Installation time is reduced.
- ★ Maintaining odorizer is quite simple. Odorizer mechanism easily accessible.
- ★ Positive seal of odorizer housing with Sillers Flex Ring Closure.

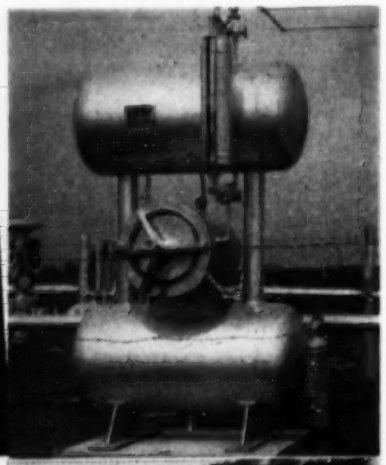
Peerless Type "MP" Odorizers have many more outstanding advantages, all engineered to give you the most accurate odorizer available.

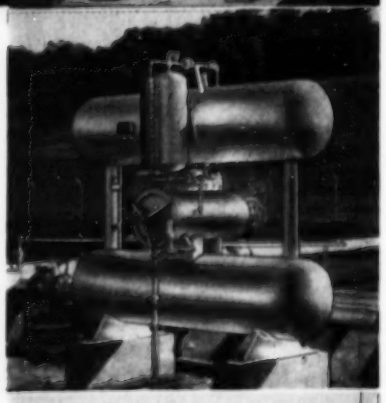
WRITE FOR BULLETIN 910

PEERLESS MFG. CO.

P. O. BOX 13165 ★ DALLAS 20, TEXAS

REPRESENTATIVES IN ALL PRINCIPAL CITIES





At the top is the MP-1000 odorizer with 85-gal. tanks. In center is the MPX-500 special with 200-gal. tanks and below is shown the specially constructed house for Peerless Packaged Odorizers.

NO PEAKS! NO VALLEYS!

Servel

***All-Year*® air conditioning**

gives you a steady year-round demand

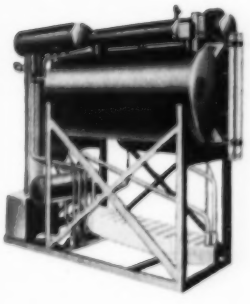
Here's one sure way to help "level out" year-round sendout. Wage a continuing, intensive campaign to promote the sale of Servel *All-Year* air conditioners on your lines.

Servel units can help you *Now!* They cool a customer's house in summer. And that means bigger and better warm-weather profits for you. And, of course, they heat in winter . . . maintaining cold-weather sendout.

Cash in on this year-round load builder. Push Servel *All-Year* air conditioning. Write for hard-selling promotion material and sure-fire sales plans. SERVEL, INC., Dept. G-95, Evansville 20, Indiana.

PUSH SERVEL FOR BIGGER SUMMER SENDOUT

Servel "add-on" gas-fired cooling units turn winter users into all-year customers and tend to give you a more equal gas demand in hot weather and cold.



PUSH SERVEL FOR MORE COMMERCIAL AND INDUSTRIAL DEMAND

Servel water chillers provide controlled chilled water for industrial pre-cooling, process cooling, and air conditioning. Help maintain a steady, important volume load at profitable rates.

Servel

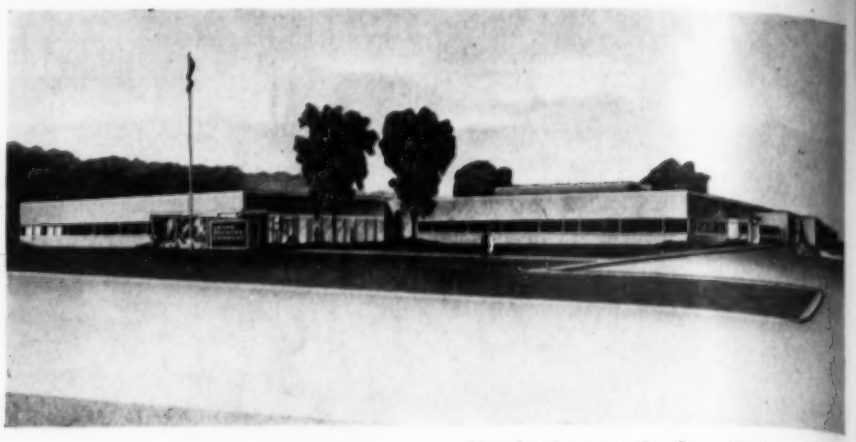
the name to watch for great advances in

AIR CONDITIONING ✓ REFRIGERATION

we have said, the decisions of the commission are *prima facie* correct, and there is no clear and satisfactory evidence in the record in this case to warrant the court in holding that the commission's decision was unreasonable or unlawful . . ."

Crane Packing to build new headquarters

Ground has been broken in Morton Grove, Ill., for two new one-story buildings which will house extensive research and laboratory operations for Crane Packing Co., as well as the office and cafeteria.



New headquarters for Crane Packing in Morton Grove, Ill.

Signalling the culmination of a three-year program, these buildings, covering 46,500 sq ft in area, are in addition to a 126,000-sq ft one-story factory building already in operation. When the project is completed early in 1956, Crane will have a new 17-acre home site for its nation-wide manufacturing and industrial service operations.

Approximately 5000 sq ft of the space will be devoted to laboratory research and testing. Design and development work will be carried on in the electronic, nuclear and similarly rapidly advancing branches of industry. Another 32,000 sq ft which will be entirely air conditioned, will accommodate the sales, executive and general offices.

Inadequate wiring cutting electric appliance sales

Electric range, water heater, dryer, and room air conditioning sales are "being lost every day due to lack of proper wiring in the homes of people who are prospects," according to J. P. Brown, manager of residential sales of Alabama Power Co., Birmingham.

The National Adequate Wiring Bureau reports that more than 80% of all electrified dwellings in the nation aren't wired adequately for the appliances being used. However, the problem of inadequate wiring reaches far beyond the home owner with the dimming TV set or non-working room cooler, according to *The Wall Street Journal*. Perhaps even more important than the affect the inadequacy is having on sales of electric utilities, electric contractors, and copper companies is its braking action on sales of electric appliances. To prevent further restricting of sales growth, utilities and

BETTER
BEST
It's no secret that Lancaster Groove Type Metal Rim Diaphragms stay in the meter longer . . . and assure sustained accuracy in gas measurement year after year. Send for a sample today.
New — BETTER SEALING
Now Lancaster offers Buna-N-Cork Meter Gaskets for better sealing! Test it in your shop and see how it solves the problem of an occasional leaking gasket. Send for a sample today.
METER PARTS CO.

Profit by national ads featuring YOU!

Over 30,000,000 **BRYANT** messages—all telling your customers to "see Mr. B"—to see YOU. Big space—full color. Tie in!

be "Mr. B"

(AUTHORIZED BRYANT HOME COMFORT DEALER)

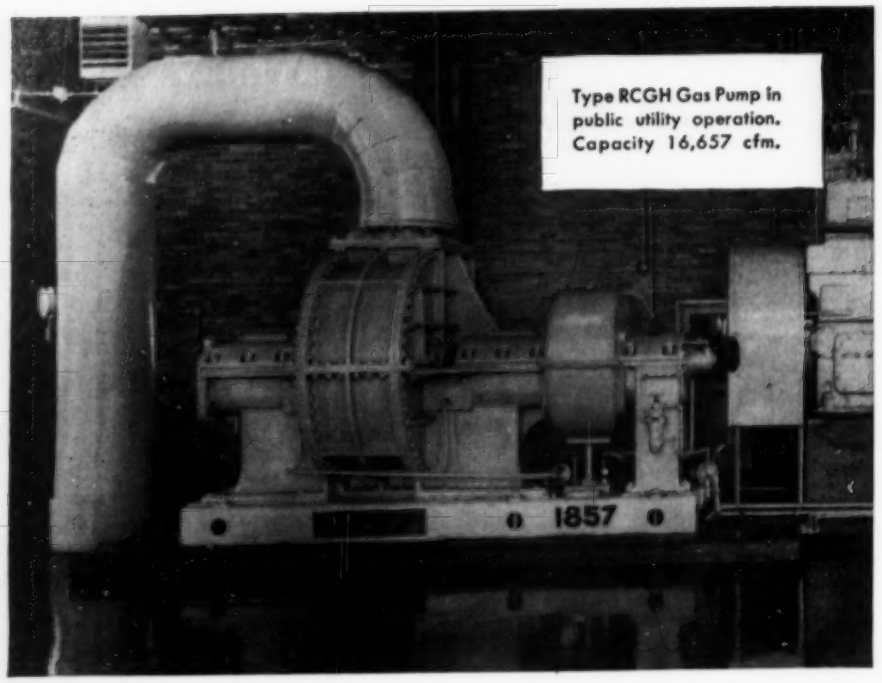
Only "Mr. B"—the Bryant Home Comfort Dealer—has *all 8* of these selling assets to build his business BIG:

1. A name customers know and want
2. The most complete line of automatic heating, air conditioning, water heating
3. Quality equipment for every market
4. Exceptional distributor service
5. Professional sales training
6. Personalized selling tools for you
7. National advertising featuring you
8. Co-op "Mr. B" ads for local papers

For bigger profits now, for a secure and prosperous future—see your Bryant Distributor. Ask him about Bryant's big "Mr. B" action program, and how it can make sales and money for you!

bryant®

AUTOMATIC HEATING
AIR CONDITIONING
WATER HEATING



Type RCGH Gas Pump in public utility operation. Capacity 16,657 cfm.

PERFORMANCE OF R-C GAS PUMPS ASSURED BY "BIG 4" ESSENTIALS

CHECK THE "BIG 4" ESSENTIALS

1. *Positive flow*—because of positive displacement principle maintaining the quantity of delivery
2. *Pressure*—controlled to your requirements
3. *Capacity*—always up to ratings, with moderate short time overloads
4. *Economy*—in first cost, power and low maintenance

You may find it profitable to compare your present gas pump performance with R-C proved economy and reliability.

For delivering or exhausting gas in industrial operations, R-C Gas Pumps and Exhausters, in either the Rotary Positive or Centrifugal types, have long demonstrated their complete reliability, efficiency and economy.

For many years, they have been the choice of plant engineers and of leading builders of industrial equipment, where the movement of gas is an essential part of the process.

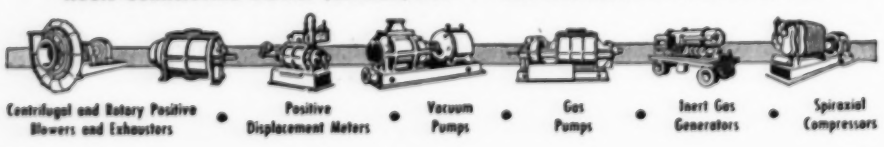
Capacities from 5 cfm to 50,000 cfm at moderate pressures offer close selections for specific needs . . . and further economies are gained from compactness, reducing space requirements and installation costs.

For any present or future project requiring gas pumps or exhausters, ask us for details on R-C equipment, and for help in planning your installations.

ROOTS-CONNERSVILLE BLOWER

A DIVISION OF DRESSER INDUSTRIES, INC.
955 Oregon Ave. • Connersville, Indiana

Roots-Connersville Blower (Canada) Ltd. • 629 Adelaide St. W., Toronto, Ont.



Centrifugal and Rotary Positive Blowers and Exhausters • Positive Displacement Meters • Vacuum Pumps • Gas Pumps • Inert Gas Generators • Spiroaxial Compressors

others are now promoting rewiring.

According to an officer of the National Association of Electric Distributors, in 1953, 15 of every 100 air conditioners sold came back to the dealers because wiring in the customers' homes could not handle the added load. Dealers now are discouraging shipping units to inadequately wired homes.

It is reported that four of every five homeowners with inadequate wiring face a cost conservatively estimated at $150 each for rewiring and new circuits. The bill may add up to $700 or $800. Apartment dwellers also have their problems. Should they or the landlord foot the bill?

General Electric President Ralph Cordiner says that even a new home or apartment house isn't a guarantee of adequate wiring. "Seventy eight and a half per cent of Manhattan's new apartment units are already inadequately wired, and 95% of these new apartments are less than five years old."

Current is brought into the home through two wires with a core the size of the lead in a pencil. Generally, the system handles 120 volts and not more than 30 amps. Multiplying amps by volts determines total wattage—and the power load a system will handle. For the home this usually is 3600 watts.

Kennecott Copper has prepared some figures showing typical wattages of various appliances: floor lamp, 150-300; vacuum cleaner, 125-700; radio, 100; TV, 300; ironer, 1650; toaster, 1100; coffee maker, 1100; broiler, 1650; room air conditioner, 1200; dishwasher, 1500; electric clothes dryer, 4500; electric range, 8000 to 16,000. By and large, cooking and large cooking and heating appliances take the most power.

Utilities helping Coleman test motor air conditioners

Cooperating with the Coleman Co, Wichita, Kan., in its development of practical residential gas-energized air conditioning, gas utilities are now running field tests on 34 gas motor units. The test program is expected to produce data that will permit final modification of the model for marketing in 1956.

Sheldon Coleman, company president and general manager, explained that the test units will operate on a normal air conditioning load during the summer. He said that controlled false loading will extend the period of test operation after the cooling season ends.

With most of the test units, he said,

the aim is to achieve a full 2000-hour season of operation. This will test dependability, one of the company's main design specifications. The unit is intended to operate without servicing for 2000 hours, equivalent to a full cooling season in the parts of the United States where the conditions under which air-conditioning equipment must operate are the most severe.

This is the second cooling season in which utilities have aided Coleman in field test work. Nineteen experimental units were on test last year.

The utilities engaged in field testing are among those that volunteered to purchase units from Coleman and test them under Coleman's direction in order to advance the date of production for sale. Mr. Coleman credits utility cooperation with the gain of a full year in development time.

In addition to the 34 units in the hands of utility companies, the Coleman company itself is testing five units and D. W. Onan & Sons, manufacturer of the special gas motor used, is testing one.

Half of the 34 utility test models are of 3-ton capacity and half are 5-ton. Utilities doing the testing are:

Arkansas Louisiana Gas Co., Arkansas Western Gas Co., Atlanta Gas Light Co., Baltimore Gas & Electric Co., Boston Consolidated Gas Co., Brooklyn Union Gas Co., East Ohio Gas Co., Gas Light Co. of Columbus, Gas Service Co., Houston Natural Gas Co., Laclede Gas Co., Lone Star Gas Co., Metropolitan Utilities District, Mississippi Valley Gas Co., Nashville Gas Co., New Jersey Natural Gas Co., Northern Illinois Gas Co., Northern Indiana Public Service Co., Ohio Fuel Co., Oklahoma Natural Gas Co., Peoples Gas Light & Coke Co., Pioneer Natural Gas Co., Savannah Gas Co., Southern California Gas Co., Southern Union Gas Co., United Fuel Gas Co., United Gas Corp., United Gas Corp., Washington Gas Light Co.

Six-month shipment mark set by gas-fired furnaces

Gas-fired warm air furnace shipments during June set two new records, for the fourth month in a row. One was an all-time high for the first six months of the year, the other a new record for June shipments.

During the first six months, 353,200 units were shipped, an increase of 40.3% over the same period in 1954. This is a greater amount than shipments for the entire 12-month period for any year before 1950. Shipments in June alone set a record for that month of 76,200 units for a gain of 33.2% over the same month last year. Seventy-five hundred gas-fired boilers

Use This Actual Job Story for an Excavating Equipment Check List!

This one water line job demonstrates a combination of features that *only* the Sherman Power Digger offers every operator of excavating and trenching equipment.

Check this performance: (1) The machine has under-dug the curb without damage to the curb or sidewalk. (2) It has trenched through rocks and roots. (3) It is digging a bellhole in the street. (4) The excavation is 9 feet deep. (5) The tractor-mounted digger has operated over the curb, sidewalk and street without damage to paving.

And the Sherman Power Digger offers even more advantages to the operator who wants the savings of mechanized excavating. It's practical even on the smallest jobs, since it releases heavier equipment for bigger jobs . . . yet it digs at a fraction of the time and cost of manual labor.

The machine digs as deep as 10 feet below ground . . . in mud, hardpan, shale, oiled roads, blacktop and stony ground. Initial cost is surprisingly low, maintenance simple and inexpensive. Ask your Ford Tractor Dealer for an on-the-job demonstration, or write us now for Bulletin No. 421.

*Designed, Engineered and Manufactured Jointly by Sherman Products, Inc., Royal Oak, Michigan. Wain-Roy Corporation, Hubbardston, Mass.

•

Patent No. 2-303-852
Other Patents Pending

•

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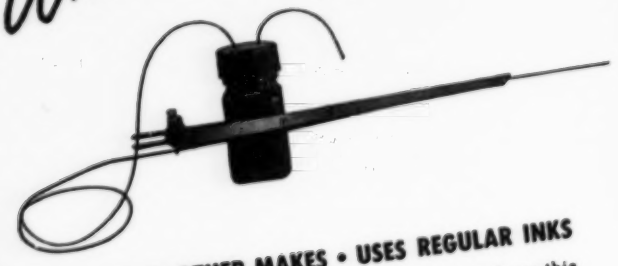
Sherman
PRODUCTS, INC.
ROYAL OAK, MICHIGAN
POWER DIGGERS* • FRONT END LOADERS • FORK LIFTS

ARCCO

ARCCO CANNON NEVER-DRY PEN

Writes for Months



REPLACES OTHER MAKES • USES REGULAR INKS

Regardless of pulsations or other causes of ink failures this new Never-Dry Pen will make clean and complete records. Ink supply lasts for several months without refilling reservoir. Capillary tube from ink bottle placed in instrument case feeds pen with continuous flow. Closed system sealed from atmosphere prevents clogging and dirt accumulation.

Weight of pen is constant at all times thus insuring extreme accuracy. No slopping or dripping. Stainless steel construction—no corrosion. When ordering, specify make and type of recording instrument.

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1897 1955

PIPE STOPPERS OF ALL KINDS

SAFETY GAS MAIN STOPPER CO. INC.

GOODMAN USED SINCE 1897 2" HANDLE & LOCKING SLEEVE GAS MAIN STOPPER

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Cable Address GASTOPPER, N. Y.

were shipped during the month, an increase of 11.9% over the same month last year and a new record for June. During the first six months of the year, 30,400 units were shipped for a 7.4% increase over the same period in 1954.

Gas conversion burner shipments were down, with 16,100 units shipped in June, a decrease of 18.3% from the same month last year.

Cobell's air conditioners rolling off the line

First 100 test models of a new gas-powered central air-condition system have rolled off the production line in Cobell Industries Fort Worth plant (see GAS, April, p 82).

Cobell president Luther Prescott says gas companies all over the nation will use the Cobaire for extensive field testing and that the results will be compounded into the production design for the 1956 models.

Rapid conversion of Cobell's Meacham field plant was started in March after the pilot model was unveiled for gas officials in Fort Worth. A 25,000-sq ft addition was built to allow production of the gas model without interference with the normal output of Cobell's standard electric Aqua-Fog models.

House rejects all highway bills

The House on July 27 rejected all highway bills. H.R. 7474, which was reported by the House Public Works Committee, called for expenditures of approximately $35 billion for highway construction over a 12-year period to be financed by special taxes on highway users. It also contained a provision covering partial reimbursement out of highway funds for the cost of relocating utility facilities necessitated by Federal-aid highway projects. This provision was deleted by the House from H.R. 7474 by a vote of 125 to 75. Then by a roll call vote of 292 to 123 the House rejected H.R. 7474.

Earlier the House had rejected by a vote of 221 to 193 the Administration's highway posposal, which called for expenditures of $25.7 billion over a period of 10 years to be financed by a special bond issue.

The House also rejected a substitute bill to H.R. 7474 which contained no financing provisions. The Senate-passed Gore bill, which provides for $12.6 billion expenditure over a five-year period and contains a utility-relocation reimbursement provision, was

killed in the House Committee. The Gore bill also lacks any provision for financing the road program.

Million-dollar Honeywell plant operating in Gardena

New production facilities costing more than $1 million have been completed for Minneapolis-Honeywell Regulator Co. in Gardena, Calif.

The new factory unit began production of gas appliance controls last month, more than doubling the Gardena operations and bringing the company's employment in that area to approximately 1200.

Additional floor space of 105,000 sq ft is provided, including office space for the Appliance Controls Division as well as for engineering and assembly.

Honeywell has also started construction of a new office and warehouse building in San Francisco, third installation built by the company in the Bay area.

SoCal introduces new appliance purchase plan

Purchase of gas appliances through a new payroll deduction plan has gone into effect at Southern California Gas Co., Los Angeles.

The new arrangement, which is being incorporated into the present employee purchase plan, will permit regular employees to buy new gas appliances—ranges, refrigerators, water heaters, and gas clothes dryers—through semi-monthly payroll deduction on maximum terms of up to 24 months.

Under the new plan, an employee who purchases an appliance through the plan completes an employee purchase contract, which is his authorization for semi-monthly payroll deductions to pay for the appliance. In this way, two payments a month are made for the appliance purchased, but the total payment remains the same as under the once-a-month payment plan.

Stockholders approve merger of Washington firms

Shareholders of Seattle Gas Co. and Washington Gas & Electric Co. voted overwhelmingly in favor of merging the two companies. The merger will become effective Nov. 1.

The name of the resulting company will be Washington Natural Gas Co.

Shareholders of Washington Gas approved an increase of the company's authorized capitalization to 1 million shares of $10 par value common stock.

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news • *Continued*

Subject to Washington PSC approval, the action will permit the issue of additional common stock from existing capital surplus on the basis of 1¼ shares for each share outstanding.

The increased authorized capital will provide necessary shares required to be exchanged for share in the new company. Shareholders of both companies will exchange for shares in the merged company on a 1 to 1 basis.

The combined company will serve Seattle, Tacoma, Everett, Olympia, Renton, Tukwila, Kent, Auburn, Algona, Pacific, Sumner, Puyallup, American Lake, Dupont, Fort Lewis, Union Hills, Lacey, Tumwater, Centralia, and Chehalis.

With the advent of natural gas in the summer of 1956, service will also be established in Bothell, Kirkland, Redmond, Bellevue, and Clyde Hill.

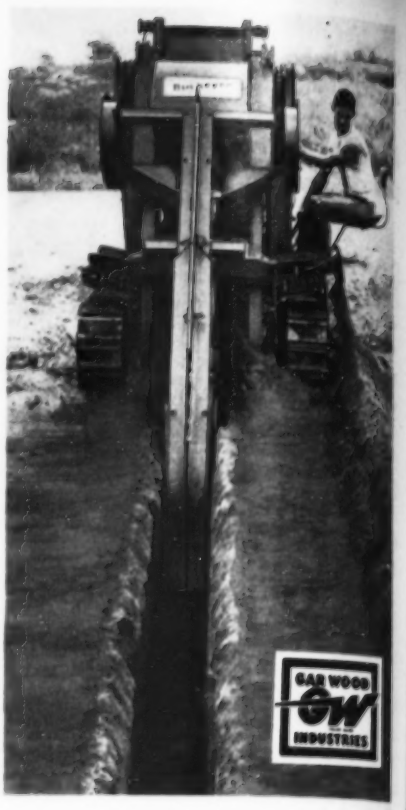
GAS news notes

A school sales program, whereby Servel Inc., through its gas utility outlets, makes new gas refrigerators available to educational institutions at special prices, is entering its fourth year of existence. Under the plan, the utility sells a Servel refrigerator directly to a school at the special price and agrees to replace the installation every two years. The biennial replacement is made at no additional cost to the school unless a larger or deluxe model is selected.

The Hardy Corp., Birmingham, Ala., has been appointed distributor for Servel air conditioning products in the Birmingham trading area.

Engineering for Cascade Natural Gas Corp.'s new construction program in 23 Pacific Northwest cities has been completed and initial specifications for bids on materials have been sent out. President Stewart Matthews said the company plans to ask for bids for some construction in about 60 days, with work to start as soon thereafter as possible. A time schedule has been drawn up for the construction of the gas distribution system in each of its cities, broken down into eight general areas with 30 individual projects.

As a major step in its planned diversification and expansion program, the Walworth Co. has concluded arrangements for the purchase of the M & H Valve & Fittings Co., Anniston, Ala The acquisition of M&H, which will operate as a division of Walworth, will



NEW BUCKEYE
MODEL 403
for Service Lines
Conduit and Cable
Small Mains

Here's the *first* and *only* low-cost production ditcher designed especially for service line work! . . . Digs flush with foundations and obstructions; eliminates hand finishing . . . Exceptionally maneuverable and highly mobile — *plus* fast ditching ability . . . Digs ditch 8", 10" or 12" wide to 5' depth; 14" or 16" wide to 4' depth.

WORKS UNDER ADVERSE CONDITIONS . . .
Full crawler mounted for high flotation and maximum traction with low ground-bearing pressure.

EASILY TRANSPORTED . . .
Small size and low silhouette permit fast job-to-job travel on small tilt-bed or flat bed trailer.

No. 5527

GAR WOOD INDUSTRIES, INC.
WAYNE, MICHIGAN

add foundry and machine shop facilities covering 200,000 sq ft and a 17-acre plant site to Walworth's regional manufacturing plants.

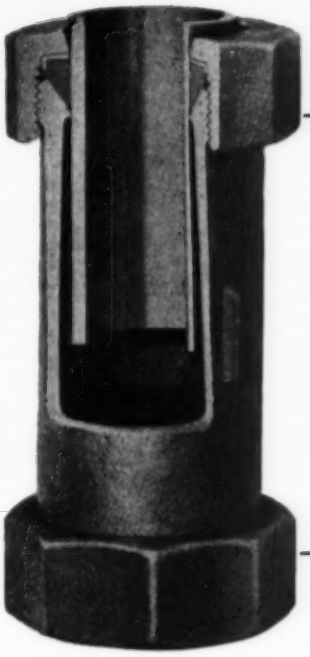
Installation of a gilded meter in the new all-gas home of Northern Illinois Gas Co.'s 500,000th customer in Rolling Meadows, Ill., highlighted the utility's special ceremonies marking the event. Owners of the new home, Mr. and Mrs. Norbert Karst, who will receive their choice of gas appliances in recognition of the event, were congratulated by Northern Illinois president, Marvin Chandler. Northern Illinois Gas has added approximately 120,000 new customers during the past five years.

New members of state regulatory commissions include Allen S. Boyd, who joins the Florida Railroad & Public Utilities Commission, succeeding Richard A. Mack, who has been appointed to the FPC; in Massachusetts, Roy C. Papalia is a commissioner to the Department of Public Utilities; Richard H. Balch and Aaron L. Jacoby are new members of the New York PSC; and in North Carolina, Ralph Moody has become a member of the Utilities Commission.

Ottawa Steel Inc., Ottawa, Kan., manufacturer of roadbuilding and industrial construction machinery, has been purchased by L. A. Young Spring & Wire Corp. The Ottawa facility becomes the Ottawa Steel division. Edwin L. Johnson, previously associated with Ottawa Steel, has been appointed general manager.

Municipal gas plant financing has been ruled against by Idaho's attorney general, thereby blocking the plans of several Idaho communities to finance and operate their own gas distribution systems. In his informal opinion, the attorney general said that a constitutional amendment would be required, or action by the legislature, to authorize general taxation or general obligation bonds to be used by municipalities to establish their own gas plants.

A bill, which, he said, "would permit a minority of stockholders of any gas or electric company" to authorize a merger with any other gas or electric company has been vetoed by Connecticut's Governor Ribicoff. For many years a two-thirds vote of the stockholders of each class has been, and still is, the accepted policy for corporations in Connecticut, according to the governor, and he sees no reason why an exception should be made for public utilities.



NORMAC

Couplings, Sleeves and Fittings

for maximum deflection, ease of "stabbing," complete confinement of the rubber!

So close are "Normac" rubbers confined at the gasket tip that possibility of flow is reduced almost to "nil." These couplings, sleeves and fittings . . . approved by gas utility men across the country for their time-saving features, ease of handling and dependable service . . . are available in a complete range of sizes. Made from air furnace malleable iron they provide greater wall thickness than pipe on which used.

NORMAC COUPLINGS are made with 5" centers in all sizes. NORMAC SLEEVES are identical in design except that they are made with 10" centers. Nuts and gaskets are interchangeable.

Compression-End Service "Tee"—First fitting of this type ever produced with full coupling depth and special threads on male end to prevent dropping into old hand taps when used to replace standard threaded fittings.

Compression-End Service "Ell" — Extra depth makes it possible to "stab" pipe into stops and without measuring, pull back a safe distance to allow ultimate deflection eliminating possibility of strain against tap in main.

Compression-End Iron Body Brass Core Service Stopcocks—End the necessity of threading on the job plus the elimination of the threads themselves—combining all the advantages of NORMAC COUPLINGS and the best in stopcock design. 2½" coupling depth on each end.

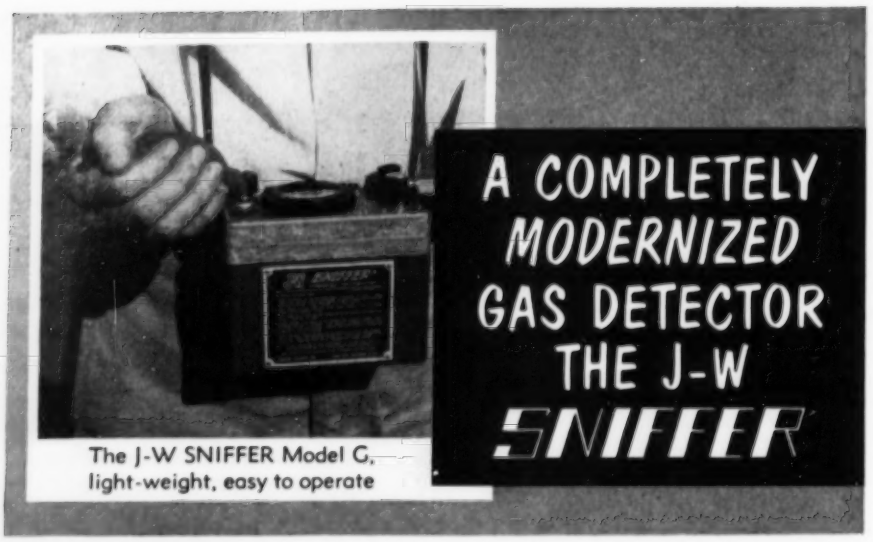
Normac Brass Fittings Developed in 1939 for Use with Copper Tubing—Our complete line of brass fittings can be used either on new installations or where copper is run through old steel pipe in large or small openings. The center to end dimensions of NORMAC TEES correspond with old malleable iron fittings. This feature is extremely important in the use of these fittings in one foot openings where the tubing must line up with the steel which has been removed.

Write for the NORMAC CATALOG of Gas Distribution Equipment

NORTON-McMURRAY MFG. CO.

122 SOUTH MICHIGAN AVENUE - - - CHICAGO 3, ILLINOIS

Couplings • Meter Bars • Sleeves • Cocks • Bell Joint Clamps • Service Tees & Ells



A COMPLETELY MODERNIZED GAS DETECTOR THE J-W SNIFFER

The J-W SNIFFER Model G, light-weight, easy to operate

Portable, Reliable

A new improved portable indicator designed for the convenience of the operator. Based on a quarter-century of experience in manufacturing gas detectors, the J-W SNIFFER Model G offers two outstanding new features: (1) automatic battery cutoff which radically extends service life and prevents leaving instrument on unintentionally, (2) new fatigue-free sample-aspirating system. Other features include: size and weight reduction consistent with rugged field requirements; corrosion-resistant Fiberglas case; use of ordinary flashlight cell batteries; and many other features.

Other Types

We manufacture a wide range of combustible gas detectors for nearly every application. Write and let us recommend the most suitable instrument for your problem.

JOHNSON-WILLIAMS, Inc.
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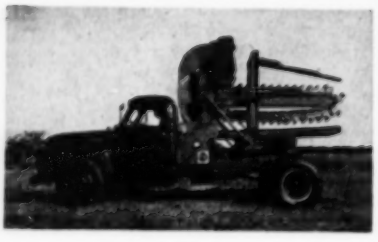

• Unique, Mobile Ditching Machine

The pioneer rubber-tired trencher, the Earthripper, will make money for you because — one man transports and operates; is self-levelling; no hand digging because it digs at any angle leaving a clean ditch; it is as easy to move as driving a truck; and it ditches to 8' deep, 10" to 30" wide.

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NEW YORK, NEW YORK
OMAHA, NEBRASKA
COLUMBIA, SOUTH CAROLINA

GAS calendar

September

7-9..Mid-West Gas Association Gas School & Conference — Iowa State College, Ames.

9..New Jersey Gas Association —Hotel Monmouth, Spring Lake, N. J.

11-13..INGAA Annual Meeting — Jasper Lodge, Alberta.

14-15..AGA Accident Prevention Conference — Marion Hotel, Little Rock.

23..Oklahoma Utilities Association Gas Division — Oklahoma City.

16-17..Maryland Utilities Association Fall Conference—Virginia Beach, Va.

25-30..International Gas Union 6th Conference — Hotel New Yorker, New York.

October

12-14..Wisconsin Utilities Association Electric & Gas Section —Schroeder Hotel, Milwaukee.

12-14..GAMA Annual Meeting — El Mirador Hotel, Palm Springs, Calif.

17-19..1955 AGA and PCGA Convention—Los Angeles.

24-27..National Association of Railroad & Utilities Commissioners—Asheville, N. C.

25..NEGA Operating Division — Hotel Statler, Boston.

November

13-18..American Society of Mechanical Engineers — Congress & Hilton Hotels, Chicago.

14-17..American Petroleum Institute —San Francisco.

16-18..Southeastern Gas Association —Roanoke Hotel, Roanoke, Va.

28-30..SGA Advisory Council & Management Conference — Grand Hotel, Point Clear, Ala.

1956

January

16-18..Pipeline Contractors Association 8th Annual Convention — Boca Raton Hotel & Club, Boca Raton, Fla.

February

15-17..Tulsa Corrosion Short Course for Pipeliners (NACE) — Mayo Hotel, Tulsa.

March

12-16..National Association of Corrosion Engineers Annual Meeting — Hotel Statler, New York.

16-19..AGA Sales Conference on Industrial and Commercial Gas — Hotel Roanoke, Roanoke, Va.

19-20..Indiana Gas Association — French Lick Springs Hotel, French Lick, Ind.

19-21..MidWest Gas Association — Hotel Fontenelle, Omaha.

22-23..New England Gas Association Annual Meeting — Hotel Statler, Boston.

22-23..Oklahoma Utilities Association Annual Convention — Oklahoma City.

April

4-6..AGA General Management Section Spring Conference — Conrad Hilton Hotel, Chicago.

16-19..AGA Sales Conference on Industrial & Commercial Gas —Hotel Roanoke, Roanoke, Va.

17-19..Southwestern Gas Measurement Short Course — University of Oklahoma, Norman.

16-18..National Conference of Electric & Gas Utility Accountants — Hotels Biltmore and Commodore, New York City.

19-21..GAMA Annual Meeting — The Greenbrier, White Sulphur Springs, W. Va.

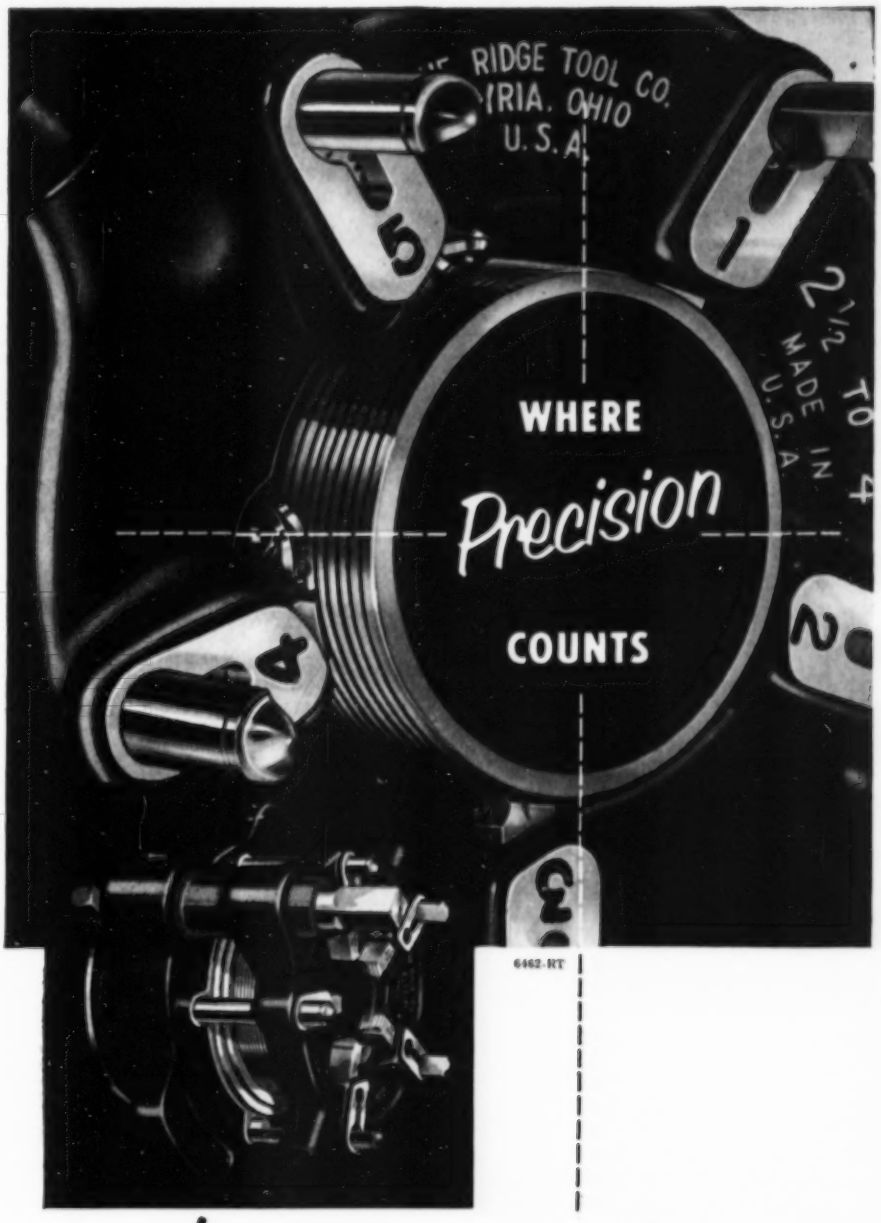
23-25..Southern Gas Association Annual Convention—Dallas.

May

7-10..AGA Distribution, Motor Vehicles, and Corrosion Conference—Congress Hotel, Chicago.

10-11..AGA Gas Supply, Transmission & Storage Conference—Conrad Hilton Hotel, Chicago.

16-18..AGA Chemical Engineering & Manufactured Gas Production Conference — Philadelphia.



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2½" TO 4" GEARED PIPE THREADER

Here's a work-saving precision tool that cuts accurate threads on 2½" to 4" pipe *every time.* It's easy to handle . . . easy to use . . . foolproof.

Operated manually or with power, the RIDGID 4P reduces time, sweat and scrap in any piping job. Balanced handles simplify carrying and starting on pipe. Mistake-proof workholder sets to size *before* tool is put on pipe . . . has only one screw to tighten . . . no bushings.

For precision and speed . . . you can't beat the RIDGID *4P!*

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Gas Digest

A digest of what's new in products and trade literature compiled by the editors of GAS as a reader service.

New Products and Trade Literature

For more data on any of these items use the coupon on the bottom of next page!

1 Air Conditioning Control

Effortless control of summer air conditioning and winter heating is claimed by use of the new Duo-Classic thermostat just announced by Detroit Controls Corp. When the Duo-Classic is used, heating, cooling, air circulation are controlled by a single switch on the thermostat.

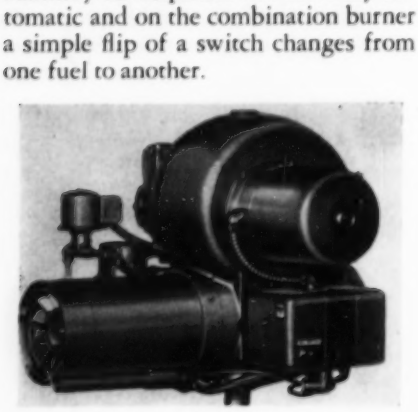
Economical operation is obtained with the Duo-Classic as it will hold the selected temperature to within a fraction of a degree, reducing the waste of over-heating and under-heating. The satin-gold case of the thermostat is complemented by a black dial, and the large Gothic numerals and graduations are easy to read against the satin black face.

Detroit Controls Corp.

■

2 Pressure Burners

Ray Oil Burner Co. has a new line of power pressure burners that are available as straight oil, straight gas, and combination gas-oil burners. All three function efficiently against positive pressure with no loss of capacity and special modifications are available to fire against positive firebox pressures of up to ¾-in. wc, generally eliminating the need for induced or forced draft fan equipment. In addition, these burners incorporate a simplified design to permit easier servicing, a flame stabilizing combustion head, and a large fan and motor providing ratings to 2.5 million Btu input with no secondary auxiliary air required. All are fully automatic and on the combination burner a simple flip of a switch changes from one fuel to another.



The main gas flame is ignited from a momentary oil firing cycle resulting in a nozzle purge with each firing cycle.

Ray Oil Burner Co.

■

3 Safety Handle

Ingersoll-Rand Co. has introduced a brand new safety development for paving breakers, a safety handle which the manufacturer claims is the first of its kind. It was developed as a result of many field requests for a safety handle to be used on tools in connection with demolition work where operators were injuring their hands when working close to walls or projecting masonry.

The new safety device weighs less than 2 lb and is available on the new Ingersoll-Rand PB8A paving breaker. It can also be purchased separately for attaching to existing PB8A models or earlier PB8A's.

Ingersoll-Rand Co.

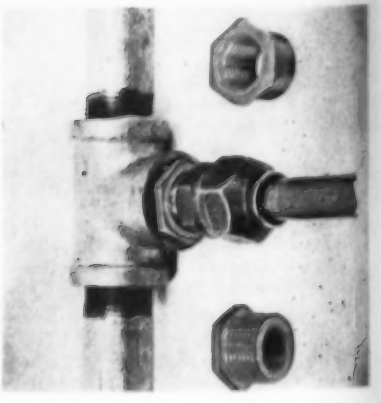
■

4 Dielectric Bushing

A new dielectric bushing for the control of electrolysis in plumbing, heating and gas applications has been developed by the May Co.

The new Mayco dielectric nylon bushing withstands temperatures up to 300°. Although it will withstand great stress, the bushing is so designed that it is encased in metal that supports it against stress when the joint is complete.

No pipe dope is necessary with the new dielectric bushings, but it can be used without adverse effect on the Nylon. No pipe wrench need be applied to the bushing because of the special tapered thread design, which makes it possible to tighten the joint by applying the wrench to the two metal fittings.



The bushings can be loosened without difficulty and do not "freeze" in the fitting.

May Co.

■

5 Trencher

New addition to the Ditch-Witch trencher line of Charles Machine Works is the Model LD, which features a variable speed transmission and completely new design.

Capable of various speeds while digging, this self-contained unit is suitable for any number of light trenching jobs. Controls are conveniently located for operating the trencher from the seat or while standing beside the machine.

The standard 6-in. wide bucket line is hydraulically controlled to a depth of 36 in. It is closed, self-cleaning, and has replaceable tool steel teeth. Spoils can be deposited on either side of the trench with the reversible spoils chute.

Charles Machine Works

■

6 Pipe Wrench

Stilsomatic Sales Corp.'s new pipe wrench offers tubular steel construction, automatic adjusting, rocking fulcrum action, spring-loaded hook jaw, and light weight.

The rocking fulcrum action of the Red Snapper allows a number of different pipe fits with only one adjustment. It also permits a snap-on feature. Once the jaws of the Red Snapper are placed on a pipe, the spring-loaded hook jaw exerts a constant pressure and will hold the wrench in place.

The wrench is available in 12-, 14-, and 18-in. sizes.

Stilsomatic Sales Corp.

■

7 Tractor Shovel

A completely new four-wheel-drive tractor shovel has been added to the Frank G. Hough Co. line. Designated as Model HO, the Payloader offers "pry-out" bucket action and 40° breakout at ground level.

In addition, the 2-cu yd capacity unit offers a newly developed "power-shift" transmission, in which the clutch pedal has been eliminated and all shifts can be made without coming to a stop or even slowing down. The pry-out bucket action is accomplished by using breakout pads on the ground as a fulcrum for leverage. Opposing load forces are transferred to the ground through the pads during the breakout, instead of to the axles, wheels and hydraulic system.

Frank G. Hough Co.

■

8 Gas Detector

A lighter, simpler, more compact instrument for detecting combustible gases and vapors is provided in the new Johnson-Williams Sniffer Model G.

To increase battery life, the on-off switch has been integrated with the aspirator bulb so that when the bulb is grasped to draw in a sample, the indicator automatically turns on. When the bulb is released, the instrument is shut off. To speed sampling and minimize operator fatigue, a new type flame-arresting system permits the use of an extremely soft aspirator bulb because of reduced resistance to air flow.

As in the previous models, the Model G is designed to be worn waist-high suspended by a carrying strap around the neck.

Johnson-Williams Inc.

■

9 Coal Tar Tape

Development of a single-wrap coal tar tape for pipe, pipe joints, fittings, and couplings has been announced by Tapecoat Co.

Tapecoat-X permits single-wrapping with only ½-in. overlap. Other advances claimed include greater coverage because of the single-wrap feature; easier application through a separator film that facilitates unrolling and automatically disappears in the application

GAS **Reader Service**

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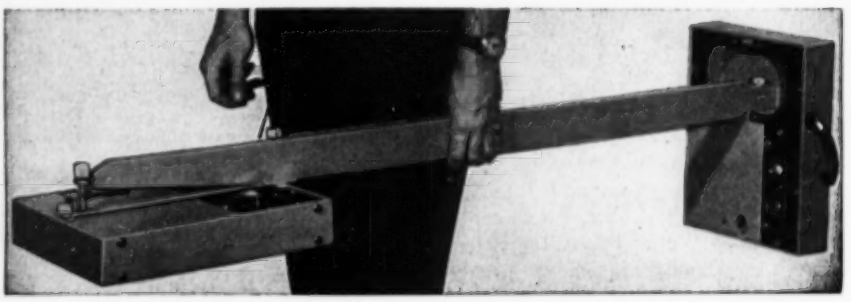
THE WILKINSON LINE LOCATOR

A precision instrument for detecting the position and depth of any sub-surface pipe, cable, stub, valve, coupling, etc.



The dependability of the Wilkinson Line Locator is amply attested by its wide use. Leading gas, oil and pipe line companies generally KNOW its value.

WILKINSON PRODUCTS COMPANY

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RELY ON

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J. E. B. GIBBONS
44 ABBOTT ROAD, BRADFORD, PA.

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NEW ENGLAND FORESTRY SERVICE, INC.
281 MAIN STREET, READING, MASS.
Tel. REading 2 2525

*Originator of Vegetation Surveys for Gas Companies in 1934

GAS Digest • *Cont'd.*

process; savings in time and labor through faster wrapping; and overall economy in material cost.

Tapecoat-X is available in rolls of 2-, 3-, 4-, and 6-in. widths.

Tapecoat Co.

■

10 Furnaces

Addition of four new thin, space saving gas-fired furnaces to its Blend-Air heating line is announced by the Coleman Co.

Both upflow and downflow models with capacities of 80,000 and 100,000 Btu input are now in production.

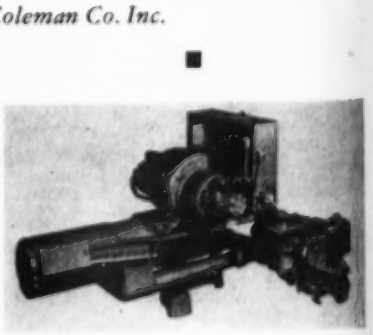
A combination of tight casing construction, heat exchanger design, and adjustable direct-drive blower enables the Coleman thin furnace to be used with the manufacturer's 3½-in. pre-engineered ducts and blenders as well as all conventional type distribution systems.

All models are designed to work as an integral part of year-round air-conditioning systems. In most installations, cooling coils may be installed in the furnace plenum and the balance of the equipment located outside the house.

Upflow units are approved for zero clearance on sides, back and base. Downflow units are approved for zero clearance on sides and back. A 1-in. sub-base is supplied as an accessory for installation on combustible surfaces.

Coleman Co. Inc.

■



11 Gas-Oil Burner

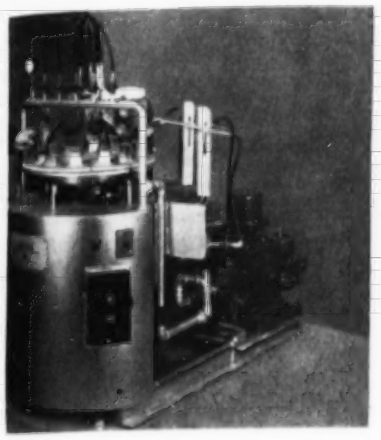
Type DFG industrial combination gas-oil burner recently introduced by Roberts-Gordon Appliance Corp. operates on city gas and No. 2 oil, and is available in three sizes covering inputs

from 360,000 to 4.3 million Btu/hr.

Built for heavy duty, with plug-in electronic controls, it is furnished with diaphragm gas valve, gas pressure regulator, double-acting barometic draft regulator, main shutoff valve, pilot flame electrode, and photo cell for oil. Manual switch-over is possible, and can be arranged to override automatic switch-over control.

Roberts-Gordon Appliance Corp.

■



12 Brazing Machine

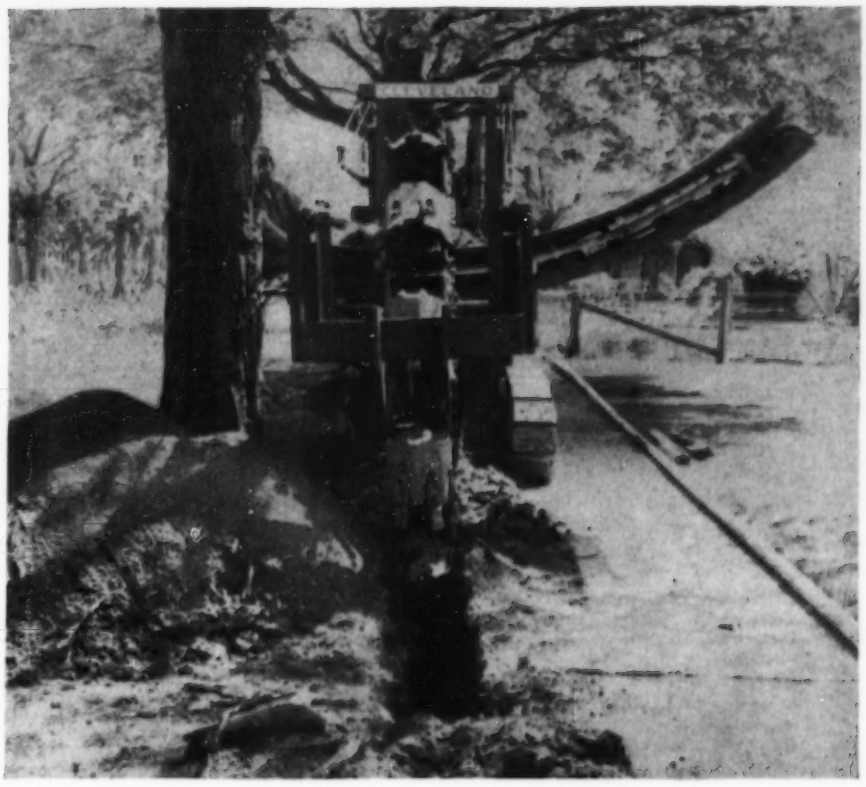
Fast, dependable automatic brazing for many types of small and medium-size assemblies is provided by new self-contained, gas-fired packaged unit developed by Selas Corp. of America.

The packaged unit uses precise control of combustion and automatic timing to produce sound brazed joints of uniform high quality at high speed. Simple joints in small parts may be brazed by one unskilled operator at rates as high as 500 assemblies per hour.

All equipment is rigidly mounted on an integral structural steel frame. This equipment includes a Selas combustion controller to deliver fuel/air mixture at a predetermined ratio and pressure; fully adjustable Selas burners to provide the optimum heat pattern and heating rate; permanent or replaceable fixtures to support the work components; a dial-type work-table to carry the assembly past the burners in continuous or intermittent motion; and all the necessary automatic timers, pneumatic indexing equipment and electric motors. Provision may be made for specialized functions such as automatic feed and delivery and air- or water-controlled cooling. Installation requires only setting the machine in place and making connections to normal shop utilities.

Although this design provides considerable versatility for general brazing operations, each automatic brazing machine is engineered to meet a range of jobs as specified by the user.

Selas Corp. of America



The "BABY DIGGER"®...

small enough for the tightest quarters ...husky enough for the toughest jobs

WISCONSIN SOUTHERN GAS CO. capitalizes on their Cleveland "Baby Digger's" compactness and maneuverability on this extension job in Lake Geneva, Wisconsin. Cleveland's quick-shift reversible conveyor made it easy to get around trees, poles and water hydrants and keep trenching operations right on schedule in spite of limited working space.

Year after year after year, Clevelands are the first choice on utility company jobs like this because Cleveland-pioneered features are needed to economically satisfy the varied job requirements called for in gas distribution work.

Recognized as supreme in its field for excellence of design, materials and construction, the Cleveland "Baby Digger's" outstanding record of long-lived dependability and economical performance is attributable primarily to Cleveland's unswerving allegiance to this basic characteristic . . . *Quality*

Your local distributor will show you how Clevelands do more—for less

THE CLEVELAND TRENCHER COMPANY • 20100 St. Clair Ave., Cleveland 17, Ohio

CLEVELAND

Telsco the tight-sealing
PRESSURE FITTING
that conducts electricity

Telsco Long and Short Couplings, Adapters, 90° Elbows, and Tees, ½ through 2 inches.

Use Telsco Fittings on Plastic Pipe, too—Metal Stiffeners for this application are available.

The unique sealing principle used in Telsco Threadless Fittings concentrates great pressure, under containment, on *all sides* of a *small* rubber gasket (See cross section). Under this tremendous pressure, confined in a small area, the gasket forms a tight seal against leaks.

At the factory every Telsco Fitting gets a 90-pound air pressure test, under water—assuring a sound casting every time.

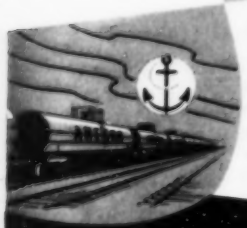
Telsco Fittings do not insulate. Instead they conduct static electricity without the time, effort and cost of bonding every connection.

TELSCO FITTINGS DIVISION
5420 REDFIELD STREET DALLAS 19, TEXAS

ANCHOR'S BUTANE & PROPANE
STAND-BY PLANT PACKAGE

ENGINEERING, INSTALLATION
Anchor's Engineering Dept. will design and supervise plant construction.

FINANCING
Anchor's experienced staff will assist with the financial details..



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NORWALK DISC TYPE CHECK VALVES
Sizes ½" thru 16"

Manufactured in both horizontal and vertical styles. Designed to give positive check against reverse flow of either gas or air. Especially suited for low pressure distribution systems. Rugged construction with low pressure drop and ease of operation. Our engineers will gladly furnish data for your applications.

SEND FOR FULL PARTICULARS

NORWALK VALVE CO.
South Norwalk, Conn.

GAS Digest • Cont'd.

TRADE LITERATURE

13 Service Catalog

Cylinder-handling trucks, appliance dollies, custom-fit appliance covers, conversion parts, servicing tools, testing thermometers, U-gauges, oven pyrometers and other related items used by servicemen are fully illustrated in the E. F. Griffiths Co. catalog.

E. F. Griffiths Co.

■

14 Vent Bulletin

Illustrated information on several new sizes of breather vents, manufactured by Universal Controls Corp. for all makes of gas service regulators is contained in Bulletin 556. Full description as to sizes and types is presented.

Universal Controls Corp.

■

15 Heating Sketchbook

The Norman Sketchbook, a new sales presentation for warm air heating dealers, is now being made available in a complete promotion package. The 32-page book is illustrated with sketches of actual homes and floor plan drawings that show where the Norman Southerner horizontal forced air gas furnace is installed.

Norman Products Co.

■

16 Compressor Bulletin

Feather valve compressors from 75 to 350 hp are the subject of Bulletin L-676-B1A from Worthington Corp. Fourteen major advantages on installation, operation and maintenance costs are outlined for types YC and DYC compressors. Information and illustrations are offered on component parts and a two-page diagram illustrates correct selection and coordination of all auxiliary equipment.

Worthington Corp.

■

17 Rubber Booklets

E. I. DuPont de Nemours & Co. has released two new publications. (When ordering copies, use letter preceding descriptive paragraph.)

a. "Facts About Hypalon" is a new publication from the Elastomers divi-

sion for maintenance, operating and design engineers. This first issue briefly describes Hypalon chemical rubber and presents a case-history account of its durability.

b. Neoprene Notebook No. 64 features the 11th article in the "Language of Rubber" series, describing the permeability of rubber.

E. I. DuPont de Nemours & Co.

■

18 Liquid Level Gauges

A 26-page bulletin from Bristol Co. describes the complete line of liquid level gauges for indicating, recording, controlling, and telemetering. The illustrated, two-color bulletin (No. L701) shows float-type, pressure-type, differential pressure-type, and bubbler-type liquid and water level gauges, in strip and round-chart models.

Bristol Co.

■

19 Gear Set Bulletin

"Nordberg Supairthermal Engine-Gear Set" is the title of a new eight-page bulletin from Nordberg Manufacturing Co. which describes the advantages of the engine-gear set for operation on large capacity gas pipelines. In addition, illustrations in Bulletin 237 shows the engine-gear set driving a centrifugal compressor and the details of the Nordberg-built speed-increasing gear.

Nordberg Manufacturing Co.

■

20 Instrument Catalog

Process control instruments are described and illustrated in Fischer & Porter's new 24-page Catalog 2. Complete specifications are presented in addition to sizing nomographs, panel mounting diagrams, safe working pressure tables, and basic operating data for the instruments described.

Fischer & Porter Co.

■

21 Automation Pamphlet

Automation in the petroleum and chemical industries is the subject of the current Kelloggram, published by the M. W. Kellogg Co. Diagrams are used throughout to illustrate the basic functions of instruments used in automatic control. Another section discusses data reduction systems. Other subjects include electronic instrumentation, stream analyzers, and high pressure instruments.

M. W. Kellogg Co.

working height only 7 FEET-4 inches

1955 50th ANNIVERSARY

with NEW Parsons 155 Trenchliner®

- **Overall height (digging) 7'4"**
- **Width (over crawlers) 5'4"**
- **Trench widths from 16 to 26"**
- **Maximum digging depth 8'0"**
- **Production from 5.8" to 25 lineal feet per minute**
- **Down-crowd boom (undercuts walks, curbs and gutters — makes vertical set-ins)**
- **Self-sharpening, reversible "Tap-In" teeth**
- **Power-shift spoil conveyor, reverse-direction belt (discharges to either side)**
- **Dual-purpose friction clutch (drives bucket line, serves as automatic safety to protect against shock loads)**
- **Full crawler mounting, with 12" flat shoes or 16" grouser type treads**
- **Low ground bearing pressure (only 4.6 to 6.1 lbs. PSI overall length on crawlers)**
- **Choice of engine (gas or diesel power available)**

For work and travel in restricted operating areas, take a look at the low overhead clearance and narrow width of this new, small, ladder-type Trenchliner. It's compact, light in weight — yet brings you a big "plus" in digging widths, depths and speeds. Check its work capacity and heavy-duty features listed here — then ask your Parsons distributor to demonstrate what this utility-size 155 can do for you.

GAS Digest of New Products and Trade Literature

TRANSMISSION PRODUCTS

22 Drilling Rig

A new kind of portable drilling rig, the Schramm Rotadrill on Pneumatractor, brings to rock drillers the advantages of rotary rock drilling with compressed air.

The unit, developed by Schramm Inc., is a complete, self-contained, self-propelled, and self-powered unit. It can drill a 4¼-in. hole to a depth of 500 ft. One-man operation is possible because all controls are arranged in one bank, adjacent to the mast. Special weight boxes and dual rear wheels on a 125-cfm heavy Pneumatractor provide 10,000-lb down pressure. Normal compressed air drilling pressures of 20 to 30 psi can be instantly increased for dewatering or breaking out blockages.

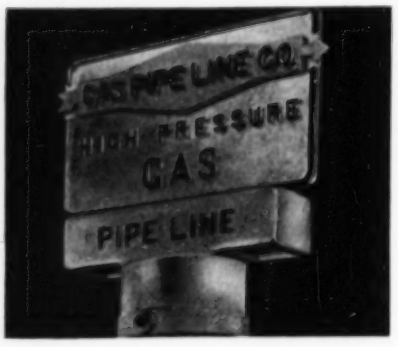
Schramm Inc.

■

23 Marker-Vent

Tod Pazdral Pipeline Specialties has added the L & M Marker-Vent to its line. The marker is a one-piece aluminum alloy casting with a 7- by 12-in. message panel and screened vents.

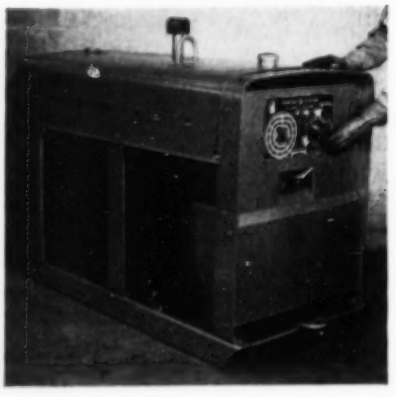
The vent openings are screened with a heavy, rust-proof, perforated metal screen to keep out insects. Models are available to fit 2-, 3- or 4-in. pipe with a weldable collar available. The Marker-Vent collar is slipped down over the top of the pipe and two Allen screws are tightened to hold it firmly in place.



This combination marker and vent eliminates the necessity of an extra sign post and greatly reduces the labor installation cost. The aluminum alloy is highly malleable and resists damage from vandalism, rifle bullets and hazards of field installation. The Marker-Vent sign panels come in standard sizes or can be individually designed to meet company needs.

Tod Pazdral Pipeline Specialties

■



24 Welder

A new 200-amp, engine-driven welder, for pipeline welding and all types of construction and maintenance work has been introduced by General Electric's welding department. NEMA-rated for a current range of 40-250 amps, the welder, designated Type WD20AG, will handle all d-c or a-c/d-c electrodes from 1/16 in. to ¼ in. with excellent welding characteristics.

Welding performance is featured by minimum load drop-off as the welder heats up, "peppy" arc and fast response, ease in arc starting, and a high instantaneous recovery voltage that prevents popouts.

The generator control consists of the tap switch and current rheostat, which allows precise current settings without need of subsequent readjustment. There are six electrode taps—one for each different electrode size.

General Electric Co.

■

25 Excavator

Pippin Construction Equipment Inc. has introduced a new model Pippin excavator and Pippin angling bulldozer for mounting on the International 300 utility tractor. The new excavator digs to a depth of more than 10 ft and loads truck to a height of 9 ft with backhoe bucket and 12 ft with shovel bucket. The front drive pump can be used for operation of both the excavator and front end attachments.

The Pippin angling bulldozer features heavy tubular push arm construction along with a low pivot point for effective dozing operation. The blade is available with angling bracket for quick angling 12½° or 25° left or right.

Pippin Construction Equipment Inc.

■

26 Shovel-Crane

Schield Bantam Co. has introduced a new self-propelled ⅜-cu yd, 6-ton shovel-crane for materials handling and industrial applications. Model designation of the new Bantam is CR-35.

Featuring 12,000-lb lifting capacity, and an outside turning radius of 19½ ft, the new shovel-crane also has two speed independent travel, which allows the operator to work the upper deck machinery and travel at the same time. The steering mechanism and brakes are controlled hydraulically, while the travel mechanism and upper machinery operate on Schield Bantam's mechanical control principle.

Shield Bantam Co.

M-SCOPE PIPE FINDER
"ELECTRONIC WITCH"
Especially Designed to Find
Hard To Locate
Gas Pipes
Price Only $162.50
Free Literature Upon Request
FISHER RESEARCH LAB., INC.
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FOR SALE: Connersville Rotary meter 12 x 36, Serial #20254, capacity 160,000 cu. ft. per hour, 25 pounds working pressure, recently overhauled, excellent working condition. Citizens Gas & Coke Utility, Indianapolis 9, Ind.

MALVERN • Mark E. Nider, Texas Illinois chief communications engineer (left), and two staff personnel observe Fax demonstration on RF and multiplexing equipment that was used.

CHICAGO • Group of Texas Illinois officials witness demonstration of facsimile equipment over the company's microwave circuit. From left: C. E. Upson, general superintendent of communications; J. J. Hedrick, president; G. P. Garver, vice president and secretary-treasurer; and Warren Bulla, superintendent of operations.

Visual proof of the feasibility of transmitting a gas pipeline company's records, charts, photos, and correspondence by facsimile equipment was dramatically given last month at . . .

The GAS Facsimile demonstration

By **FRANK CHAPMAN** • Editor-Manager

HOUSTON • Watching demonstration in Houston offices were (from left): H L. Mauldin, district engineer, and C. R. Worst, superintendent of production, Texas Illinois; J. Fred Ebdon; and Margaret Dill, Texas Illinois.

USE of facsimile equipment for the transmission of records, charts, photographs, correspondence and all types of printed and written material ordinarily found in the day-to-day operation of a major cross-country gas transmission pipeline was demonstrated for the first time last month under the sponsorship of GAS magazine.

The demonstration was carried out over the Texas Illinois Natural Gas Pipeline Co. microwave system between Houston and Chicago. Cooperating with GAS in the project, besides the pipeline company, were Motorola

Part 1

Communications and Electronics Inc., manufacturer of the pipeline company's microwave equipment; and Acme Telectronix Division of NEA Service Inc., manufacturer of the facsimile equipment.

Purpose of the demonstration was to develop technical and operational data on the application of facsimile over a gas pipeline company's microwave system. The technical data were concerned with the signal handling capabilities of the microwave channel, using the transmission of facsimile signal as a test medium. The operational phase of the test was for the purpose of investigating those pipeline operations where facsimile might be of value.

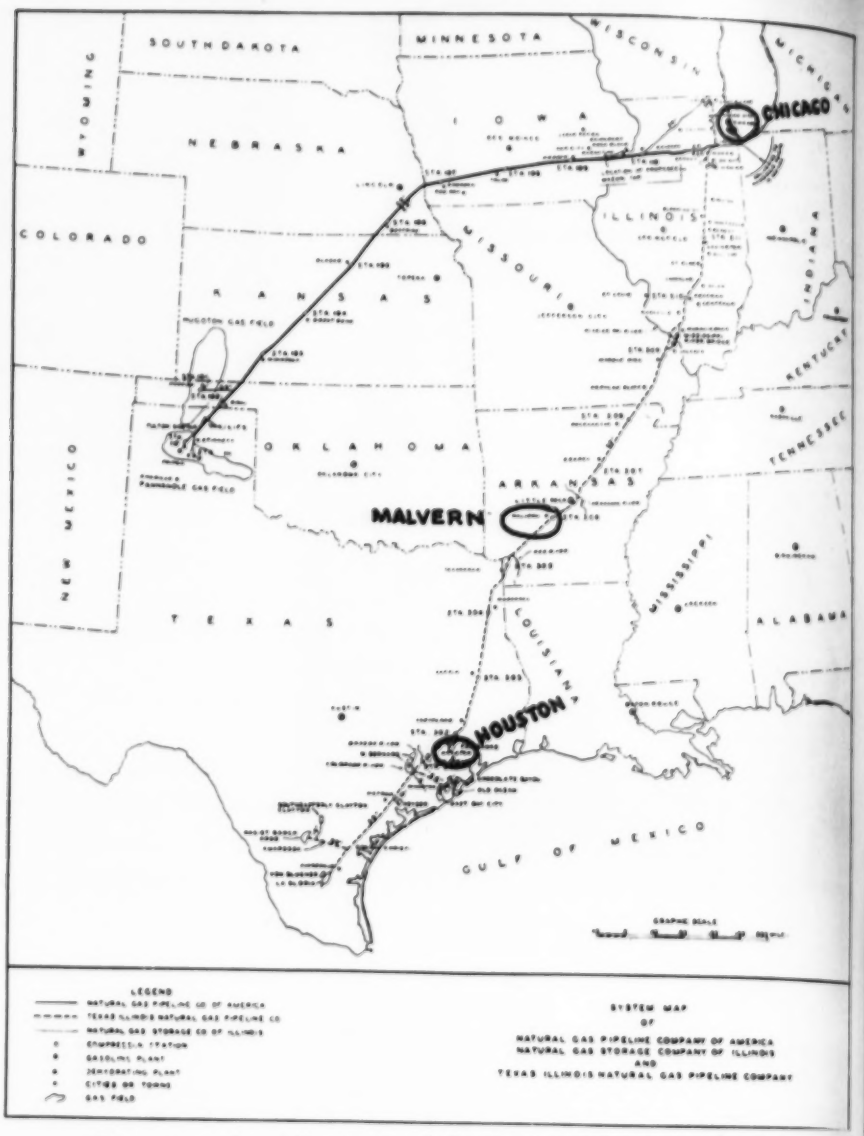
The project was one of several industry participation projects that GAS has sponsored over the past year as a service to the gas industry.

Two-day test

The undertaking consisted of a two-day test and demonstration during which a wide range of operating information in graphic form was transmitted among three test locations along the route of the pipeline. The first day was primarily devoted to the technical aspects of setting up and putting the test into operation while the second day served as a simulated demonstration of the equipment in actual use as a medium of pipeline communications.

Because of the industry-wide interest that developed in the project, the demonstration on the second day also served to allow interested persons to witness the equipment in actual operation. Some 70 gas industry engineers and executives, and representatives of allied fields took advantage of this opportunity at one of the three test locations.

In commenting upon the results of the test, Warren Bulla, superintendent of operations for Texas Illinois, pointed out that "the demonstration was indicative of another step in the continuing trend toward the use of automation in the gas industry." He said that the results of this test will furnish valuable information for the industry as a whole in the realm of communications, which he termed the most important link in any system of automation.



The route of Texas Illinois Natural Gas Pipeline Co.'s microwave system, highlighting the three points of the two-day demonstration.

Actual conditions

For purposes of the test every effort was made to simulate actual operating conditions as nearly as possible. Locations selected for the facsimile transmitting and receiving equipment were those where graphic information might be expected to originate for transmission or be received from other points. Thus equipment was installed at Chicago, Texas Illinois' general office; Malvern, Ark., where the company's field operating headquarters are located and the site of a compressor station; and in Houston, the company's production headquarters.

As a further step in making the test as realistic as possible, C. E. Upson, superintendent of communications for Texas Illinois, asked each department head to submit sample material that might logically be used for facsimile transmission from point to point along the route of the line. The material received as a result of this request was edited down to include the greatest variety of types of copy.

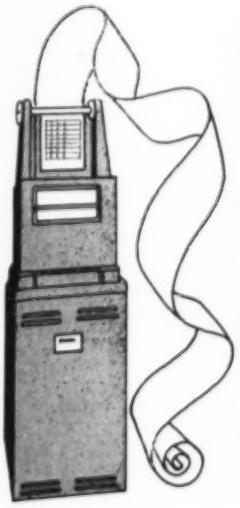
Three identical sets of all material chosen were then prepared and made available at each of the three points participating in the test so that a direct comparison could be made of micro-

wave circuit characteristics between all three test points.

Most of the available test material was transmitted on the first day of the test. On the second day, however, the copy was further edited down and scheduled to permit visitors a better opportunity to witness the operation. Also on the second day photographs were taken of those witnessing the demonstration at the various test locations and these were transmitted to the other points participating in the test. Thus it was possible for visitors to any one point to see the physical arrangement of equipment at the other two, and to see an actual application of the equipment for the transmission of on-the-spot photographs.

Except for minor difficulties caused by the temporary nature of the set-up, the quality of the recorded copy was perfect throughout the test. Those visiting each of the test locations and inspecting the recorded copy were enthusiastic in their comments on the results of the demonstration.

Representatives of Acme Telectronix Division of NEA Service Inc., in commenting upon the use of the company's facsimile equipment over a microwave circuit, said that the recorded copy was as good as any that had been transmitted over high grade wire line circuits. In the 14-hour-long test, extending over the two days, during which copy was transmitted almost continuously, there was not one instance of microwave circuit trouble evidenced in the recordings. This type of channel reliability is, however, becoming commonplace with microwave.



Part 2

How the facsimile equipment transmits the copy

THE facsimile equipment used in the test has been in use for a number of years by news picture agencies and military organizations. In the news picture service the equipment is used for the world wide transmission of pictures from news gathering centers and the scene of news stories direct to newspaper offices and television stations. The military agencies have long employed facsimile for radiophoto transmission of photographs, maps and similar information from the various theaters of operation.

In the facsimile process light values that vary with the density range of the original copy to be transmitted are converted into values of voltage that may be transmitted over radio or wire lines. At the receiving end the facsimile recorder reverses the process by changing voltage values into light values, for recording on light sensitive photographic paper or film, or current values for electrolytic recording on chemically treated paper.

At the transmitter, copy to be transmitted is fastened around a rotating drum on the top of the equipment and scanned by an optical system that is driven laterally across the drum by a lead screw mechanism. A photo-multiplier tube in the optical unit converts the changing light values reflected from the surface of the scanned copy to values of output voltage. When white on the copy is scanned the tube delivers maximum output, while black, or the absence of reflected light, delivers minimum output.

Direct current output

The direct current output from the photo-multiplier tube is used to amplitude modulate the output of a constant frequency oscillator operating at 2100 cycles per second. Output of the facsimile transmitter, therefore, is a maximum audio frequency signal for white and minimum for black, with the remaining tones of the scanned copy falling between these two extremes. White is ordinarily set at zero level while black usually falls to about minus 30 DB.

A standard-frequency tuning fork in the transmitter develops both the signal frequency and the constant frequency voltage that drives the synchronous drum and lead screw motors. An identical fork in the recorder keeps the two equipments in synchronization.

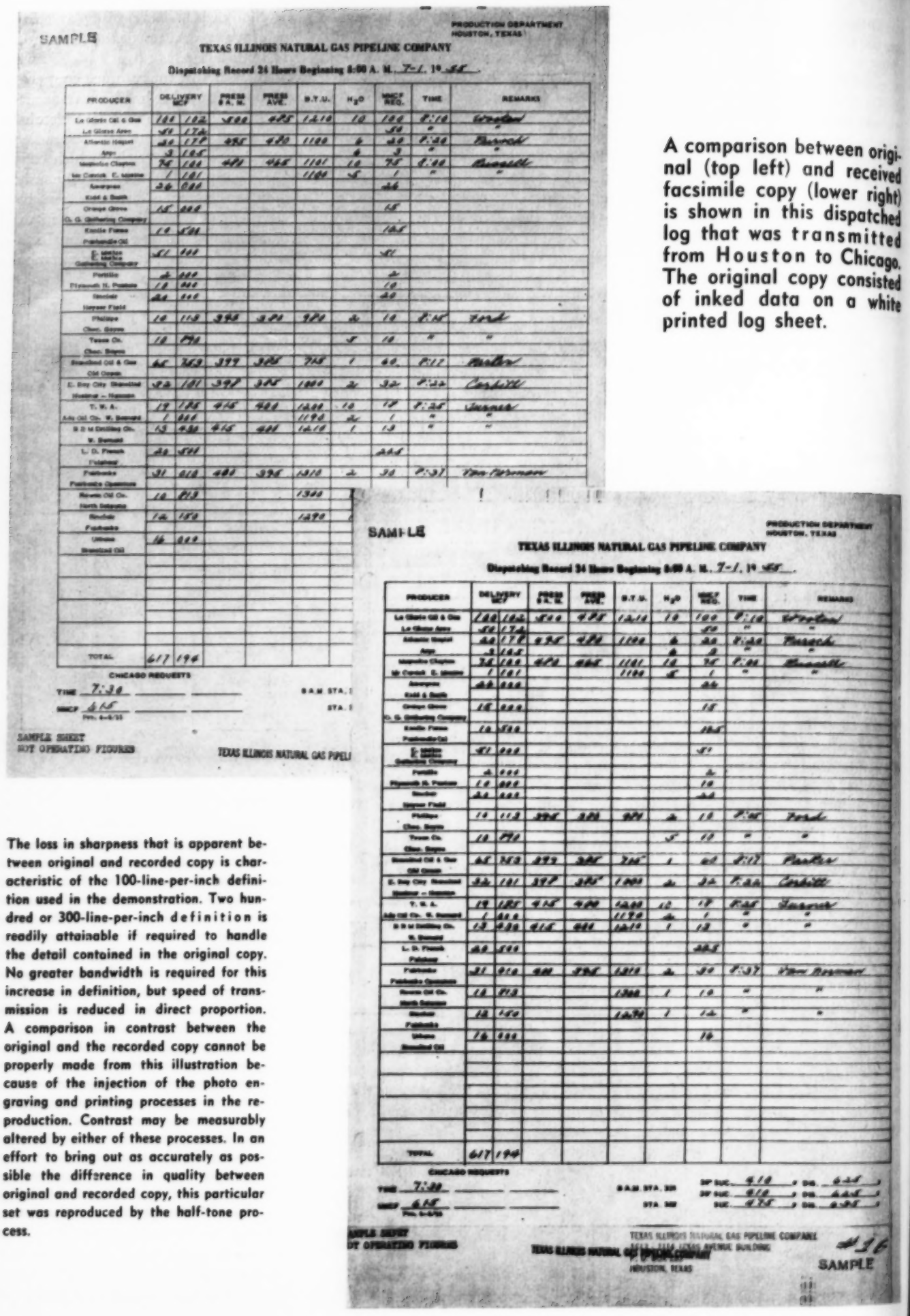
The transmitting drum will take copy as large of 9 by 12 in. Circumference of the drum is 9 in. and it is 12 in. long. For purposes of the test all sample copy was fastened to a 9- by 12-in. piece of backing paper to aid in handling.

The copy was scanned at 100 lines per inch, which, with a drum speed of 100 rpm, resulted in a scanning speed of 1 in. per minute. Thus, letter-size copy was transmitted in about 10 to 11 minutes. Recording was at the same speed and definitions.

Automatic recorder

The facsimile recorder used for the test is completely automatic in operation. When the transmitting operator sends a synchronizing signal the recorder automatically synchronizes and sets level for the picture. When the picture is completed the machine continues to operate until the received copy has cleared the front of the machine, even if no other transmission is immediately forthcoming. However, if no other transmission is made after the previous recording has cleared the machine, the equipment goes on stand-by until another transmission is made.

The recording is made on a continuous roll of chemically treated paper. In the recording process the paper passes between a rotating drum on which is mounted a helical blade and a recording bar. The rotating helix and stationary bar develop a point contact on each side of the paper that travels laterally across it from one side to the other. The recording is done by a cur-



SAMPLE

PRODUCTION DEPARTMENT
HOUSTON, TEXAS

TEXAS ILLINOIS NATURAL GAS PIPELINE COMPANY

Dispatching Record 24 Hours Beginning 8:00 A. M. 7-1, 19 55

PRODUCER	DELIVERY MCF		PRESS 8 A. M.	PRESS AVE.	B.T.U.	H_2O	MCF REQ.	TIME	REMARKS
La Gloria Oil & Gas	100	102	500	495	1210	10	100	8:10	Winston
La Gloria Area	50	174					50	"	"
Atlantic Hoyet	20	170	495	490	1100	6	20	8:30	Pinnock
Agg.	3	105				4	3	"	"
Magnolia Clayton	75	100	490	485	1101	10	75	8:00	Bennett
Mr Carroll E. Moore	1	101			1100	5	1	"	"
Anderson	26	000					26		
Kidd & Smith									
Orange Grove	15	000					15		
G. G. Gathering Company									
Kinzie Fiesa	10	581					105		
Panhandle Oil									
[illegible] Gathering Company	51	000					51		
Portilla	2	000					2		
Plymouth N. Pumice	10	000					10		
Shriner	20	000					20		
Lawyer Field									
Phillips	10	113	395	391	990	2	10	8:15	Ford
Chas. Boyce									
Texas Co.	10	790				5	10	"	"
Chas. Boyce									
Stanolind Oil & Gas	65	369	399	395	745	1	60	8:17	Hunter
Old Ocean									
E. Bay City Stanolind	32	101	397	395	1000	2	32	8:22	Corbett
Hackney - Hanson									
T. W. A.	19	185	415	410	1200	10	19	8:25	Jaynes
Ada Oil Co. W. Bennett	1	000			1190	2	1	"	"
B D M Drilling Co.	13	930	415	411	1210	1	13	"	"
W. Bennett									
L. D. French	22	581					225		
Pickney									
Fairbanks	31	010	401	395	1010	2	30	8:37	Van Norman
Fairbanks Operations									
Reverie Oil Co.	10	913			1300				
North Delaware									
Rachele	14	150			1490				
Fairbanks									
Ullman	16	000							
Stanolind Oil									
TOTAL	617	194							

CHICAGO REQUESTS

TIME 7:30 _____ _____ S.A.M. STA.

MCF 615 _____ _____ STA.

Pro. 6-6-55

SAMPLE SHEET
NOT OPERATING FIGURES

TEXAS ILLINOIS NATURAL GAS PIPELI

SAMPLE

PRODUCTION DEPARTMENT
HOUSTON, TEXAS

TEXAS ILLINOIS NATURAL GAS PIPELINE COMPANY

Dispatching Record 24 Hours Beginning 8:00 A. M. 7-1, 19 55

PRODUCER	DELIVERY MCF		PRESS 8 A. M.	PRESS AVE.	B.T.U.	H_2O	MCF REQ.	TIME	REMARKS
La Gloria Oil & Gas	100	102	500	495	1210	10	100	8:10	Winston
La Gloria Area	50	174					50	"	"
Atlantic Hoyet	20	170	495	490	1100	6	20	8:30	Pinnock
Agg.	3	105				4	3	"	"
Magnolia Clayton	75	100	490	485	1101	10	75	8:00	Bennett
Mr Carroll E. Moore	1	101			1100	5	1	"	"
Anderson	26	000					26		
Kidd & Smith									
Orange Grove	15	000					15		
G. G. Gathering Company									
Kinzie Fiesa	10	581					105		
Panhandle Oil									
[illegible] Gathering Company	51	000					51		
Portilla	2	000					2		
Plymouth N. Pumice	10	000					10		
Shriner	20	000					20		
Lawyer Field									
Phillips	10	113	395	391	990	2	10	8:15	Ford
Chas. Boyce									
Texas Co.	10	790				5	10	"	"
Chas. Boyce									
Stanolind Oil & Gas	65	369	399	395	745	1	60	8:17	Hunter
Old Ocean									
E. Bay City Stanolind	32	101	397	395	1000	2	32	8:22	Corbett
Hackney - Hanson									
T. W. A.	19	185	415	410	1200	10	19	8:25	Jaynes
Ada Oil Co. W. Bennett	1	000			1190	2	1	"	"
B D M Drilling Co.	13	930	415	411	1210	1	13	"	"
W. Bennett									
L. D. French	22	581					225		
Pickney									
Fairbanks	31	010	401	395	1010	2	30	8:37	Van Norman
Fairbanks Operations									
Reverie Oil Co.	10	913			1300	1	10	"	"
North Delaware									
Rachele	14	150			1490	1	14	"	"
Fairbanks									
Ullman	16	000					16		
Stanolind Oil									
TOTAL	617	194							

CHICAGO REQUESTS

TIME 7:30 _____ _____ S.A.M. STA. 329 2nd SUC. 410, DIS. 625

MCF 615 _____ _____ STA. 340 2nd SUC. 610, DIS. 625

Pro. 6-6-55 SUC. 485, DIS. 625

SAMPLE SHEET
NOT OPERATING FIGURES

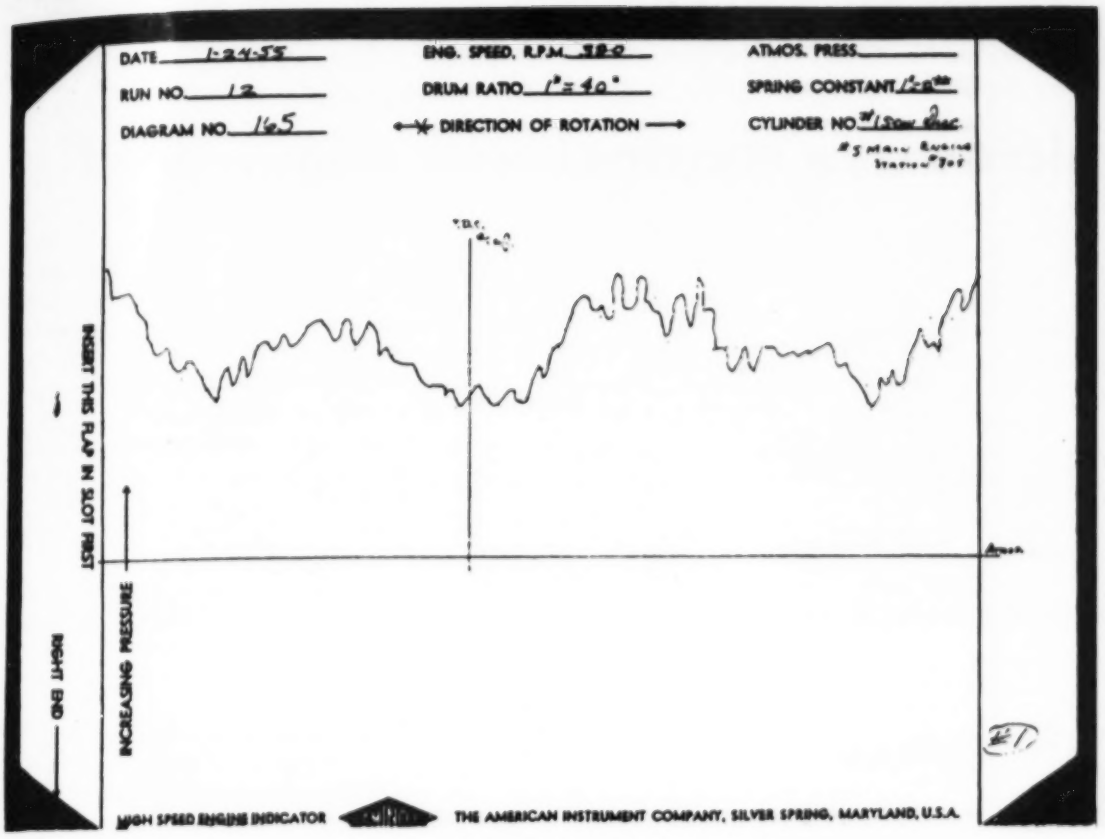
TEXAS ILLINOIS NATURAL GAS PIPELINE COMPANY
1514-1516 TEXAS AVENUE BUILDING
HOUSTON, TEXAS

TEXAS ILLINOIS NATURAL GAS PIPELINE COMPANY

SAMPLE

A comparison between original (top left) and received facsimile copy (lower right) is shown in this dispatched log that was transmitted from Houston to Chicago. The original copy consisted of inked data on a white printed log sheet.

The loss in sharpness that is apparent between original and recorded copy is characteristic of the 100-line-per-inch definition used in the demonstration. Two hundred or 300-line-per-inch definition is readily attainable if required to handle the detail contained in the original copy. No greater bandwidth is required for this increase in definition, but speed of transmission is reduced in direct proportion. A comparison in contrast between the original and the recorded copy cannot be properly made from this illustration because of the injection of the photo engraving and printing processes in the reproduction. Contrast may be measurably altered by either of these processes. In an effort to bring out as accurately as possible the difference in quality between original and recorded copy, this particular set was reproduced by the half-tone process.



Representation of an actual piece of copy transmitted from MIT engine - indicator card. This particular property was indicative of the manner in which contrasts may be increased as desired. The original card was a pencil line on a blue background. In order to make a readable transmission, it was necessary to make an adjustment in the facsimile equipment to increase contrast. **(See page 115.)**

rent that passes through the paper from helix to bar at this point.

The amplitude modulated signal that is received from the transmitting point is used to control the amount of current that passes through the paper at this point. Since maximum current results in maximum recording or black on the recorded copy, the circuit is designed to cause minimum input signal (black from the transmitter) to result in a maximum current. Maximum signal from the transmitter on the other hand (the transmitter output that results from white in the original copy) causes minimum current to flow and results in a white recording.

Recorded image

The recorded image becomes visible, a line at a time, at the point where current flows between the helix and bar. As the copy is recorded it moves upward across the front of the machine where it may be inspected. Once a piece of copy has cleared the recording area it may be cut off the roll.

Like the transmitter, the facsimile recorder is a self contained unit requiring only a source of power and connection to a suitable communication medium.

Since the transmitters used in the test were tranceivers capable of receiving on photographic film or paper, a few test transmissions were received simultaneously on both the facsimile recorder and the photo recorder. The photographic recording was therefore available for comparison with the copy recorder on the facsimile machine using an electrolytic recording process.

For photo recording, film or photographic paper is mounted on the same drum used for transmitting, except that the drum is now housed in a light-tight box. Exposure is made with a light beam that varies in intensity with the input signal from the transmitting point. After the copy has been completely exposed it must be processed photographically, and, if a film is used, a print must be made from it for use.

SAMPLE

Station # 305

Main Engine # 6

Cyl. No.	IHP	Bot. Temp	Bot. Press	Suc. Press	% Load
1	224	730	475	230	100
2	214	690	460	225	97
3	218	705	485	210	97.5
4	232	705	470	220	104
5	216	720	495	228	97
6	220	740	460	210	98
7	229	730	450	226	102
8	220	735	465	217	98
9	242	725	460	224	108
10	220	695	475	213	98
Total	723740				

(Calculated) ICHP = 1900 HP
(Chart) ICHP = 1940 HP
Mech. Eff. = 1940/2237 = 86%

Sample recorded copy of engine performance data transmitted from Houston to Chicago. Original copy was in pencil on ordinary yellow tablet paper. Contrast was sufficient to give good recorded reproduction.

Part 3

Special microwave channel was engineered

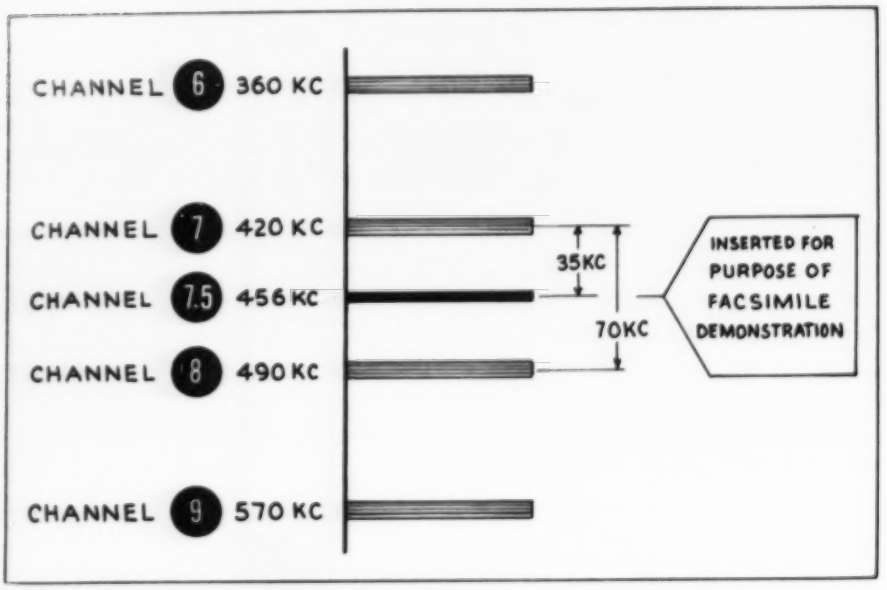


Diagram showing manner in which Channel 7½ was inserted in the microwave circuit to provide a channel for the facsimile transmissions without altering any of the other services on circuit.

NO FEATURE of the test was more interesting than the manner in which a special temporary microwave channel was set up to handle the facsimile transmissions without discontinuing or disturbing any of the system's existing services. The extra channel was inserted into the system between existing channels seven and eight and thus came to be known as "Channel 7½."

The Texas Illinois microwave system is a Motorola 12-channel system that was first put into operation in January 1952. It is currently engineered to handle 13 channels.

The system's northern terminal is atop Chicago's 42-story Civic Opera building, which also houses the company general offices, while its southern terminal is at Hungerford, Texas, near Houston. Total length of the system is 1068 miles, and it includes 40 stations. The system operates in the 6000-7000-mc. band.

Channel 7½ was set up with the use of multiplexing equipment from Motorola's new 24-channel microwave system. Operating at a frequency of 456 kc it was possible to insert the channel between existing Channel 7, operating at 420 kc, and existing Channel 8, operating at 490 kc. The 24-channel equipment was sufficiently stable and selective to function properly without interfering with other channels. A band width of from 300 to 3000 cycles, satisfactory for handling the facsimile signal, was easily attainable. No changes in the microwave system, other than insertion of this channel, were made.

The Motorola 24-channel equipment operates from 400 kc to 800 kc with 16 kc spacing, while the existing Texas Illinois system for 12 channels operates from 160 kc to nearly 1 mc. with varying amounts of spacing between channels. It was necessary to install voice-

Photo of Texas Illinois microwave RF equipment and antenna at Chicago terminal, which was transmitted from Chicago to Houston. This, among other photos transmitted, represents the photographic quality of the facsimile process.

Large group of those who witnessed the facsimile demonstration in the Houston office. Included in the group are (5th and 6th from left) C. L. Pringle, Motorola industrial communications engineer, and E. D. Nuttall, research engineer at United Gas Co. Shreveport laboratory.

terminating equipment and sub-carrier transmitters from the 24-channel equipment at each of the three test locations.

On the transmit side, the amplitude modulated audio tone output from the facsimile transmitter was used to modulate the microwave sub-carrier transmitter operating at 456 kc. On the receive side the reverse took place with the microwave sub-carrier receiver demodulating the 456-kc frequency modulated signal. Output of the sub-carrier transmitter was an amplitude modulated signal of identical frequency as that delivered by the facsimile transmitter.

Channel 7½ was set up as a four-wire circuit with Malvern's transmitting and receiving equipment connected to both sides of the circuit. This arrangement permitted a transmission from any one point to be received simultaneously at the other two. It also minimized the amount of equipment required to make the installation of the channel.

Connected

Facsimile transmitters and recorders were connected together at each of three points so that the recorders also monitored all transmissions from the transmitter associated with it at that location. This practice not only served well for the demonstration but, in actual practice, would serve to make a record copy of each transmission for use of the transmitting point.

In Chicago the facsimile equipment was located in a conference room adjacent to the offices of the various operating department superintendents. Conection was made to the microwave multiplexing and radio frequency equipment on the building's 40th floor through a transmit loop, a receive loop, and a switching loop for turning on and off the sub-carrier transmitter.

Locations

In Houston the equipment was located adjacent to the microwave equipment in the company's production office. In Malvern the facsimile equipment was located in the communications office with tie lines similar to those used in Chicago to connect the equipment to microwave gear located in another building on the grounds of the compressor station.

In no instance throughout the entire test was there any evidence of degradation in the quality of the recorded copy due to the microwave circuit. Since even the most minute absence of signal during a period of transmission would show up as a black line in the recorded copy, any such loss of signal would have been easily discernible.

Lack of sufficient bandwidth to handle the facsimile signal and its sidebands would have been evidenced in a general loss in detail in the recorded copy. Several pieces of copy with fine detail were particularly selected for the test to show this characteristic of the circuit. On careful inspection no loss of detail, over that to be expected in the scanning and recording process, was to be found.

The high degree of definition retained in the received copy indicated that the frequency response and differential phase characteristics of the microwave channel were more than ample to reproduce the facsimile copy. It was pointed out that the necessity of faithfully reproducing both frequency and phase placed a greater demand on the channel than that required by voice transmission.

Signal-to-noise ratio was measured on the circuit and found to be in excess of 40 DB. This proved to be satisfactory for the elimination of any noise pattern in the recorded facsimile copy.

While it was apparent from the test that photographs might play an important role in any actual application of facsimile to pipeline operations, it was pointed out that if only copy such as letters, figures and copy of this kind, with only solid black and solid white, were to be transmitted, the bandwidth requirements could be considerably reduced. Also, if only this copy were to be transmitted the facsimile equipment could be adjusted for higher contrast, which would produce better line copy at the expense of photographic copy.

Part 4

Operating people see demonstration as confirmation of microwave reliability

ALTHOUGH a detailed analysis of the operational results of the test will take lengthy consideration, comments with respect to the use of facsimile by some of the departments participating gave a good picture of the kind of service that it might be expected to offer the operating divisions of a major gas pipeline company. The matter of urgency in getting information from one point to another along the route of the system and the elimination of errors in the handling of words and figures by voice were the two major advantages that were evident to all who took part.

Compressor station department people saw an application of facsimile as a means of transmitting pictures of engine or equipment failure from a field location to a field or general headquarters either as a matter of information or for engineering analysis. A situation was visualized where it would be valuable to have a picture of a worn or broken part transmitted from the field to a point where it could be analyzed by supervisory or engineering personnel, by a supplier or a consultant. Facsimile in this application would

Date March 24, 1955 Station 111 CHECK OF SF LUBRICATORS

SAMPLE

Eng. No.	Power Cylinder Lubricator: Driving Hole	Power Cylinder Lubricator: ½	Power Cylinder Lubricator: No. of Flats Power Cyl	Power Cylinder Lubricator: No. of Flats Power Rack	Power Cylinder Lubricator: Theoretical Oil per Lube Qts. per @ 125 Cyl	Power Cylinder Lubricator: Theoretical Oil per Lube Qts. per @ 125 Rack	Compressor Cylinder Lubricator: Power Cylinder Feed: Driving Hole	Power Cylinder Feed: ½	Power Cylinder Feed: No. of Flats Power Cyl	Power Cylinder Feed: No. of Flats Power Rack	Power Cylinder Feed: Theoretical Oil per Lube Qts. per @ 125 Cyl	Power Cylinder Feed: Theoretical Oil per Lube Qts. per @ 125 Rack	Comp. Cyl. Feed: No. of Flats Comp. Cyl	Comp. Cyl. Feed: No. of Flats Comp. Rack	Comp. Cyl. Feed: Theoretical Oil per Lube Qts. per @ 125 Cyl	Comp. Cyl. Feed: Theoretical Oil per Lube Qts. per @ 125 Rack	Theoretical Consumption Oil Per Unit Qts. per hr. @ 125: Power End	Theoretical Consumption Oil Per Unit Qts. per hr. @ 125: Comp. End
1	Outer	12.5	44.6	29.7	.0355	.0236	Outer	12.5	44.9	31.5	.0357	.0251	65	31.5	.0518	.0253	.761	.257
2	Outer	12.5	44.9	31	.0357	.0247	Outer	12.5	45.1	30.1	.0359	.0239	59.1	30.1	.047	.0239	.767	.236
3	Outer	12.5	45.3	32.8	.0362	.0261	Outer	12.5	49	33.5	.039	.0283	61.5	52.1	.049	.0415	.801	.279
4																		
5																		
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13																		
14																		
15																		
16																		
17																		
18																		

Differential (⅝" Dia. × ⅛" Dia.) Plunger Area = 0.0276 sq. in.
Straight (⅝" Dia.) Plunger Area 0.3491 sq. in.
1 Flat = .0886" stroke

½ = RPM of Engine Cam Shaft / RPM of Lubricator Shaft

Displacement of 1 Plunger @ 125 RPM

Diff. Type = .0098 R
Straight Type = .0779 R
Qts./Flat hr.

TEXAS ILLINOIS NATURAL GAS PIPELINE COMPANY
SAMPLE
SF 3

Sample of lubricator data chart used in the demonstration. Data figures were typed on a printed data sheet.

not only be faster than the mails but it would also obviate the inadequate verbal description.

It was also pointed out by compressor station people that the use of pictures would be applicable in the case of an accident of one kind or another where a verbal description of the damage is often inadequate for the purposes of management's evaluation. It was suggested that the Land "picture in a minute" camera could be used to advantage in any application of this nature.

Another application

The compressor station department saw another application in the transmission of engine performance, or MIT, cards from compressor stations to field and general offices for engineering analysis. The engine performance card is recorded automatically and shows the condition of both power and compression cylinders in the form of a curve on a sheet of paper. By proper analysis of the curve it is possible to predict engine trouble and schedule preventive maintenance (see p. 111).

Sample engine performance cards showing desired operating conditions might also be transmitted from engineering or supervisory offices to a man in the field to help him in correcting his trouble.

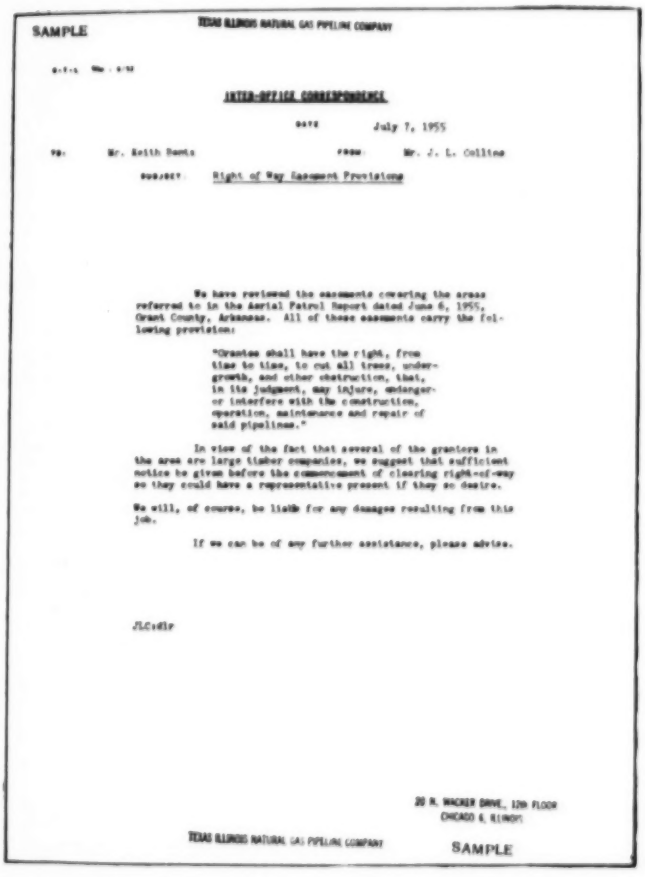
The problem evident in the reproduction of low contrast copy was more evident in the engine performance cards than in any of the other material selected for transmission. The cards currently used by Texas Illinois have a dark blue background and the curve is made with a pencil line which follows an automatically recorded series of dots. The contrast between the blue background and the pencil marking, while good enough for analysis in its original form, is too low for a suitable transmission.

It would be possible to increase the contrast and produce copy suitable for transmission either by using cards with a lighter background or by transferring the curve to some other material with a lighter background. A considerable improvement could be made merely by tracing the curve in ink rather than pencil.

Right-of-way

The pipeline department saw a use for facsimile in any instance where a field office requires detailed information as quickly as possible on some phase of the company's agreement with land owners adjacent to the pipeline right-of-way. Only brief abstracts of easements are kept in field offices. Detailed information on any one point must be supplied from the general office where the complete document is on file.

An example was seen where an aerial patrol report showed some kind of activity, mining or construction of one kind or another, adjacent to the pipeline right-of-way. It might be necessary in an instance of this kind for a field man to quickly determine the


SAMPLE

TEXAS ILLINOIS NATURAL GAS PIPELINE COMPANY

INTER-OFFICE CORRESPONDENCE

DATE July 7, 1955

TO: Mr. Keith Davis FROM: Mr. J. L. Collins

SUBJECT: Right of Way Easement Provisions

We have reviewed the easements covering the areas referred to in the Aerial Patrol Report dated June 6, 1955, Grant County, Arkansas. All of these easements carry the following provision:

"Grantee shall have the right, from time to time, to cut all trees, undergrowth, and other obstruction, that, in its judgment, may injure, endanger or interfere with the construction, operation, maintenance and repair of said pipelines."

In view of the fact that several of the grantors in the area are large timber companies, we suggest that sufficient notice be given before the commencement of clearing right-of-way so they could have a representative present if they so desire.

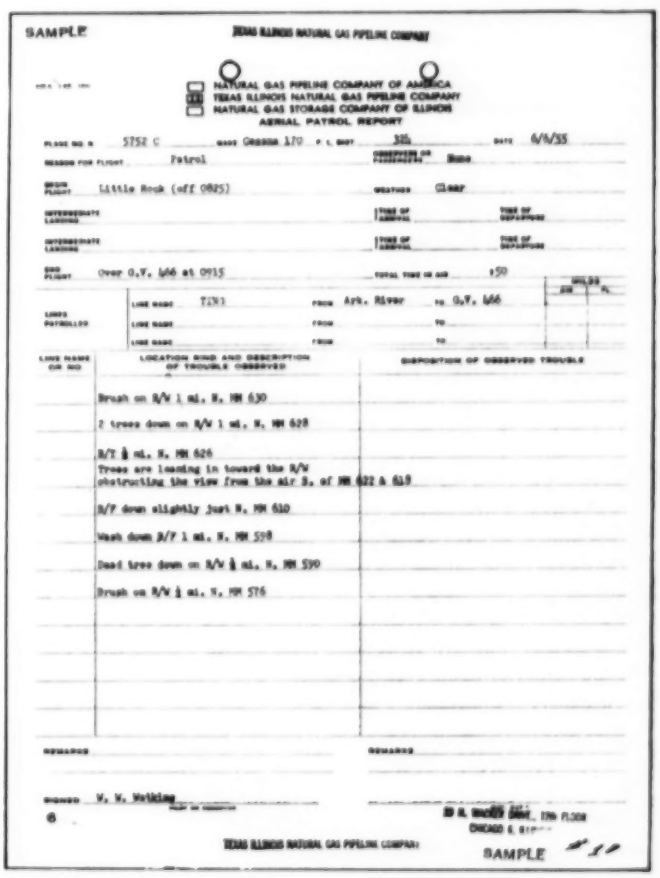
We will, of course, be liable for any damages resulting from this job.

If we can be of any further assistance, please advise.

JLC:dlr

20 N. WACKER DRIVE, 12th FLOOR
CHICAGO 6, ILLINOIS

TEXAS ILLINOIS NATURAL GAS PIPELINE COMPANY SAMPLE


SAMPLE

TEXAS ILLINOIS NATURAL GAS PIPELINE COMPANY

NATURAL GAS PIPELINE COMPANY OF AMERICA
TEXAS ILLINOIS NATURAL GAS PIPELINE COMPANY
NATURAL GAS STORAGE COMPANY OF ILLINOIS
AERIAL PATROL REPORT

PLANE NO. N 5752 C MAKE Cessna 170 P. L. MOT 335 DATE 6/6/55

REASON FOR FLIGHT Patrol CONDITION OF PASSENGERS None

BEGIN FLIGHT Little Rock (off 0825) WEATHER Clear

INTERMEDIATE LANDING TYPE OF LANDING TYPE OF DEPARTURE

INTERMEDIATE LANDING TYPE OF LANDING TYPE OF DEPARTURE

END FLIGHT Over U.P. 466 at 0915 TOTAL TIME IN AIR 1:50

LINE PATROLLED: LINE NAME T2X1 FROM Ark. River TO U.P. 466

LINE NAME OR NO. | LOCATION KIND AND DESCRIPTION OF TROUBLE OBSERVED | DISPOSITION OF OBSERVED TROUBLE

Brush on R/W 1 mi. N. MM 630

2 trees down on R/W 1 mi. N. MM 628

R/T ½ mi. N. MM 626
Trees are leaning in toward the R/W obstructing the view from the air S. of MM 622 & 619

R/T down slightly just N. MM 610

Wash down R/T 1 mi. N. MM 598

Dead tree down on R/W ½ mi. N. MM 590

Brush on R/W ½ mi. N. MM 576

REMARKS REMARKS

OBSERVER W. W. Watking

20 N. WACKER DRIVE, 12th FLOOR
CHICAGO 6, ILLINOIS

TEXAS ILLINOIS NATURAL GAS PIPELINE COMPANY SAMPLE

Sample of a two-part transmission that might be handled over a microwave facsimile circuit. Copy on the right is an aerial patrol report describing right-of-way conditions that might have been transmitted from somewhere along the route of the pipeline to the company's Chicago general offices. Interoffice correspondence on the left contains an excerpt from a contractual agreement between the company and a landowner that might have been transmitted from the Chicago office back to the field office. This is a sample of an operational application of transmission going to both ends—one the result of the other.

Facsimile demonstration... Photos showing ROW condition might be transmitted

exact wording of the company's agreement with the owner of the land on which the activity has been noticed. Another example would be the case of a landowner with which the company has an agreement who is contemplating the sale of all or part of his property. In this instance it might be urgent to correlate the property in question with respect to the pipeline.

Information of this kind on contractual agreements is currently transmitted verbally (when speed is a factor) or by mail. Facsimile might be substituted in those instances when it is urgent to get a signature or exact copy of the document to a field office.

Picture transmission

Pipeline people could also use facsimile for the transmission of pictures showing the condition of the pipeline right-of-way or adjacent areas. This application would be similar in most instances to the use of pictures by the compressor station department.

Dispatching personnel seemed to feel that the bulk of their reports were not particularly applicable to transmission by facsimile because operators prefer to discuss the figures as they are verbally called into the central office. It is general practice for the receiving operator to question any irregular figures as he tabulates them on his report. Even in instances where there is a satfactory explanation for an irregular figure, this practice tends to help the central office dispatcher to be more intimately aware of the condition of his system.

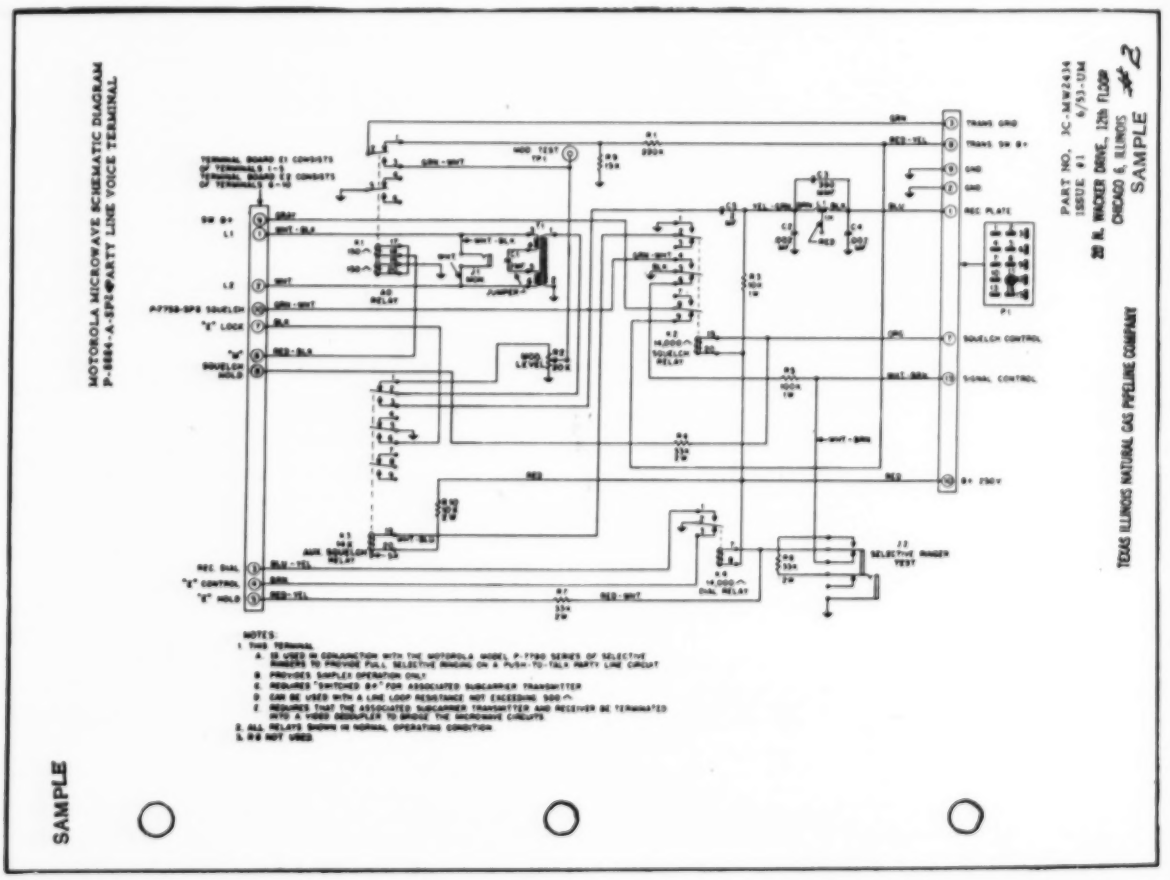
The dispatching department did, however, find a use for facsimile in connection with drilling reports which, in the Texas Illinois operation, are handled by dispatching personnel. Reason for this use, in addition to the reasonable amount of urgency involved, is the fact that the reports use a terminology or "lingo" characteristic of the production field that is not familiar to dispatching personnel and hard for them to understand.

The transportation department seemed to think that it would be of value to them if pictures of materials or equipment damaged in transit could be transmitted fro mthe field to the central office where adjustment is handled, or to the original supplier for his information. Since there is some urgency involved in receiving a report on materials damaged in transit this, also, could be transmitted by facsimile. The report could be of considerably more value if accompanied by a picture of the damage; particularly if both were available at the central office as soon as possible.

Paperwork

Copies of freight bills and other paperwork involved in shipping were also items that transportation department people seemed to feel would be worthy of facsimile transmission.

In the matter of the transmission of



Typical wiring diagram that might be transmitted as a service to the company's communications department. This might well show a modification of an existing circuit or circuit of entirely new equipment.

Facsimile demonstration... Meter charts could be transmitted in some usages

orifice meter charts for billing purposes, the gas accounting department pointed out that a transmitted purchase or sales meter chart would not be suitable for accounting purposes because of the possibility of a slight change in dimension due, principally, to shrinkage of the recording paper plus the fact that the original chart is the only accepted legal record for this purpose.

The paper used in the facsimile recording process is subject to a change in dimension because it is moist when recording and heat dried shortly after the recording takes place. Also, some change in dimension between original and recorded copy might result from the process of transmission when the transmitting drum circumference is not exactly equal to the recorded line length at the receiver, or when the lateral movement of the transmitting optical unit is not exactly equal to the speed of travel of the recording paper through the facsimile receiver. In the photo recording process the developing and printing of photographic film and paper also results in some dimensional change.

Dimensional change

For most purposes the dimensional change resulting from these factors is of no concern. However, when orifice meter charts are used for customer billing or the purchase of gas, any error that is inherent in facsimile transmissions of this kind is not acceptable. For instance, one 10-in. orifice meter chart transmitted as a part of the test decreased in diameter to 9⅞ in. on the recorded copy. The decrease was equal in both dimensions, indicating that it was due to overall shrinking of the paper, rather than any mechanical difference between the transmitter and recorder.

A parallel can be drawn between this application of facsimile and the use of telemetering equipment to produce orifice meter charts at a distant location. Again, the only legal chart for accounting purposes is the one recorded at the point of purchase or sale. Because of the possibility of error in the telemetering equipment, or the communications circuit over which the telemetering signal is transmitted, a chart recorded at a distant point is not acceptable.

If visual integration of the charts were used it could be shown that although a dimensional change took place in the process of transmission, no error would result because the grid of base lines upon which the recording is made is also transmitted and therefore subject to an equal and corresponding dimensional change. However, with automatic integrating methods which are ordinarily used the integrating equipment does not operate from the base grid lines of the transmitted chart and would therefore produce an inaccurate reading were there any dimensional change.

Visual analysis

Where orifice meter charts are used for the visual analysis of operating conditions, facsimile transmission would be highly acceptable. Instances of this kind would be the transmission of recording charts showing water content, specific gravity or Btu of gas.

In the Texas Illinois method of operation, gas purchase orifice meter charts are integrated at certain field locations near the point of purchase and payment made on the basis of this read-

SAMPLE

TEXAS ILLINOIS NATURAL GAS PIPELINE COMPANY

MAKE CHECKS PAYABLE TO CHICAGO, ROCK ISLAND AND PACIFIC RAILROAD COMPANY

Rock Island

FREIGHT BILL

Form 898

STATION Little Rock
FREIGHT BILL NO. 316

CONSIGNED Texas Illinois Natural Gas Pipeline Co.
DESTINATION c/o M. M. Whitson
ROUTE CMSTPP & RI

To CHICAGO, ROCK ISLAND AND PACIFIC RAILROAD COMPANY, Dr., For Charges On Articles Transported

STATION FROM / POINT AND DATE OF SHIPMENT	CAR INITIAL AND NO. / CONNECTING LINE REFERENCE	FULL NAME OF SHIPPER / PREVIOUS WAYBILL REFERENCE	CAR INITIALS AND NO. / ORIGINAL CAR INITIALS AND NO.
No. Milwaukee Wisc.	7-15-55 M 36155	A. O. Smith Corp.	RI 90018

NUMBER OF PACKAGES, ARTICLES AND MARKS	WEIGHT	RATE	FREIGHT	ADVANCES	TOTAL
15 pcs wrot stl pipe 30 in od.	62400	60	266.95		306.99
W.18 195 Dunn 300 A&D		15%	40.04		
				us tax	9.21

LOCATION		RECEIVED PAYMENT FOR THE RAILROAD COMPANY	FREIGHT SYMBOL L.C.L. FRGT	$TOTAL PREPAID		
WAREHOUSE	POST OR SECTION			$	TOTAL	316.20

AGENT
CASHIER

"Route of the Rockets".
Thank You, Patronage is appreciated

FOR USE AT JUNCTION POINTS ON FREIGHT SUBJECT TO CONNECTING LINE SETTLEMENT
(JUNCTION AGENTS WILL, ON CONNECTING LINE TRANSFERS, INDICATE BY SYMBOL HOW WEIGHT WAS OBTAINED)

TEXAS ILLINOIS NATURAL GAS PIPELINE COMPANY 20 N. WACKER DRIVE, 12th FLOOR CHICAGO 6, ILLINOIS

SAMPLE

Sample of a freight bill submitted by the company's traffic department from one point to another, showing delivery of supplies.

Facsimile demonstration... Flat-type scanner would broaden usefulness of equipment for pipelines

ing. Each chart is later re-read in Chicago for record purposes only.

In the operation of the company's communications department, facsimile would be valuable in any instance where there might be a modification in an electrical circuit to be made known to engineers along the route of the system. Even minor circuit modifications such as the change in a resistance value or the change in a portion of a circuit are difficult to explain verbally. The transmission of all or any part of a circuit involved would eliminate any possibility of error.

Plans and specifications for new construction or the modification of existing structures might also be transmitted by facsimile. For example, it was pointed out that a rough sketch for a proposed change in plans for a field structure might be transmitted to a central office for verification. Also, such a sketch might be used by a central office draftsman to make a complete drawing.

Still another possibility would be an instance where there is a question about the specific location or nature of an element in a structure under construction or modification. A drawing or sketch of the structure might be transmitted, whereupon the receiving point could make a notation on the received copy and re-transmit it back to the point from which it originated.

Administrative functions

The administrative functions of a pipeline company would find uses for facsimile similar to those that might be evidenced in any company with widespread operations. Such matters as the rapid gathering of payroll informa-information, the dispatch of office notices and general correspondence are only a few of the possibilities evident from the current test. Additional uses in this category too numerous to mention might be found in any operation.

With respect to the run-of-the-mill administrative type material, it was pointed out that the restrictions on size of copy that the transmitter can handle would prove to be a distinct disadvantage in many applications. Copy for transmission must be 9 in. in one dimension in order to fit the copy-clamping arrangement on the transmitter drum, and no longer than 12 in. in the opposite dimension. It is possible, of course, to mount smaller copy on a backing with this dimension, but this process proved to be inconvenient during the test.

The problem is concerned with documents, legal size copy, maps, charts and material of this kind that is too large for the transmitter drum and not adapted to cutting into smaller sections for obvious reasons. To make a reduced copy of material of this kind expressly for transmission would involve a considerable additional manipulation.

Forthcoming solution

A solution to this problem that may be forthcoming is the flat type scanner that is currently under design by another company. With equipment of this kind it would be possible to use any size copy. It would also have the advantage of being able to scan material that cannot, for one reason or another, be wrapped around a transmitting drum.

In major construction along the route of an existing pipeline, facsimile would be of invaluable service for the exchange of sketches, drawings and specifications concerned with the project. The speed and accuracy with which changes and clarification in plans might be handled between the company and its construction department or a contractor would save considerable time and expense.

Operational aspects

In analyzing the operational aspects of the test as a whole it seemed significant that any conclusions to be drawn were closely associated with the basic structure of company operating procedures and, in some instances, the basic operating practices of the entire gas industry. It was readily obvious that facsimile could be used for any number miscellaneous operations now handled in some other manner, but once a more thorough investigation was undertaken it became evident that certain underlying practices were involved.

As it becomes more and more feasible to bring system-wide information to a central point through the use of facsimile as well as similar techniques, centralized control becomes more attractive. This, in turn, leads to the use of automation, remote supervisory control and all the automatic devices associated therewith. The changes that might be envisioned are too widespread and varied to warrant discussion in this article.

Preliminary analysis

A preliminary analysis based upon the current tests does appear to indicate that facsimile equipment as applied to gas pipeline operations has the following possibilities:

A. Apparent possibility for use where it is of value to quickly transmit information in graphic form from one point to another in the system, particularly when an exact duplicate of the original is preferred at the distant point.

B. Potential application only after certain basic organizational or operational changes have been made. These instances are where the size or quality of copy is not currently suitable for transmission, but adaptable to change; and where certain organizational changes would need to be made in order that facsimile transmissions might provide a useful service.

C. No apparent application in those instances where some technique or industry practice will not logically permit the use of transmitted copy for one reason or another. ■

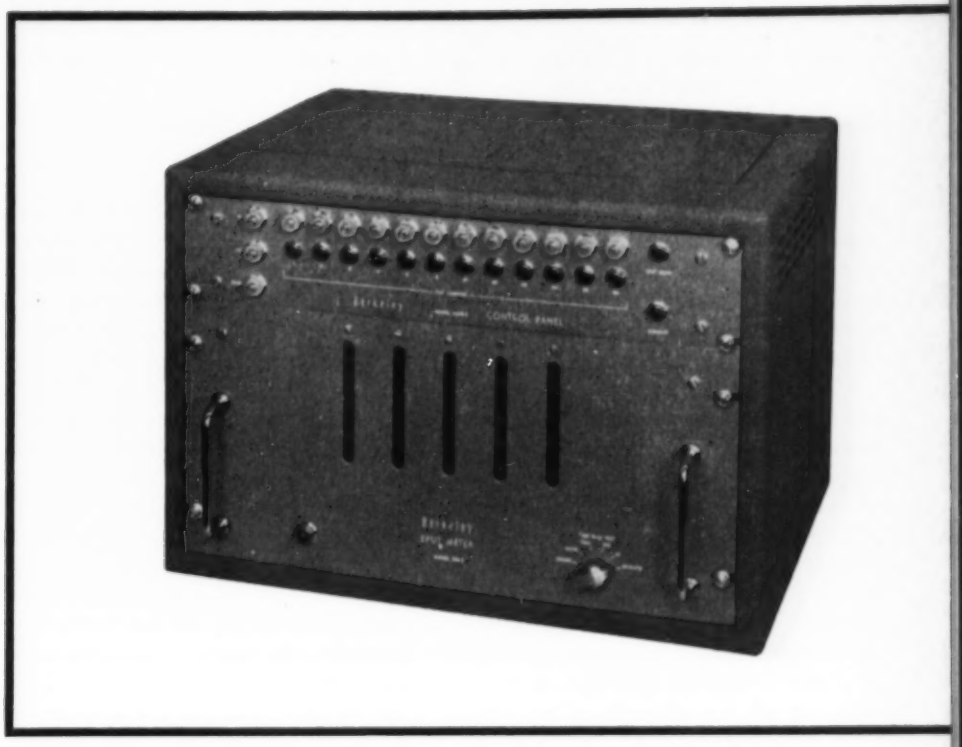


Fig. 1. EPUT meter, which is a part of each remote station transmitter.

Pipeline telemetric control sent on a standard teletype circuit

By JAMES R. CUNNINGHAM • Berkeley Div., Beckman Instruments, Richmond, Calif.

When a standard teletype network is used for basic pipeline communication, it is often economically advantageous to increase the utilization of the system by installation of auxiliary equipment so that it becomes the common carrier for an automatic telemetering system. This article describes how one gas transmission company extended its network in this manner.

TELEMETERING systems are used in pipeline operations to produce a degree of automation that will save money through the reduction of operating manhours at compressor and measuring stations; however, it is equally important that a telemetering system provide efficiency, ease of operation, accuracy, economy of operation, and an easy maintenance program. A properly designed and installed telemetering system will also facilitate maintenance of confidence and good relations with the pipeline's customer utilities. In addition to the advantage from an operational standpoint, a prime purpose of a telemetering system is to enable engineering personnel at division and main offices to watch operation characteristics and make available to them information and data for design or revision of the physical property.

As a gas company finds an increased need for providing automatic control and data transmission, there is the natural tendency to increase the scope of the automation by requiring more features in the telemetric service, but an economical system must be maintained at the same time. Overall system errors become of the utmost importance and practically exclude use of normal impulse type transmission. The high cost of microwave system for long distance transmission imposes a severe limitation on its widespread use.

In most instances, a standard teletype network is planned for normal system communication. One of the important requirements therefore is the utilization of this teletype as the common carrier for the automatic telemetering system. Additional requirements include the transmission of a number of analogue

010	1	XXX	2	XXX	3	XXX	4	XXX	5	XXX	6	XXX
	01	XXX	02	XXX	03	XXX	04	XXX	05	XXX	06	781

Fig. 2. Typical transmission.

quantities from one remote station to a control office, transmission of one or several teletypes on an "as called for" basis, detailed coding of all data transmitted, and test features to ensure that transmitted data are correct.

The automatic teletype system described here meets the specific design needs of gas companies requiring precise analogue quantities from a number of substations correlated at a control dispather's office. This system consists of automatic teletype transmitters installed at remotely located stations. Any number of stations can be installed and all stations transmit on a single teletype line. Bell Telephone provides the common carrier for telemetered information, the receiving devices, and the means for requesting the information from a particular station. All the requirements are filled by a standard 19ASR teletype and a 64C1 selection; Plans 1 and 14.

Each remote station requires a complete transmitter *(Fig. 1)* which includes an EPUT* meter, a control panel, a control unit, a converter unit, a power supply unit, and transducers. The transmitter is a complete teletype transmitting station, providing automatic transmission of up to 12 sets of pressure (static or differential), temperature, and rpm readings. Data are fed directly from transducers to 12 inputs on the station's control unit chassis. When activated, the station will transmit these data as three-digit numbers prefixed by numerical designation of the channel being indicated. A station code will also be transmitted so that readings from this station will not be confused with data from other transmitters. This teletype transmission may be received by a standard teletype receiver at the receiving station. The dispatcher at the receiving station may dial any automatic transmitter, activating a standard 64C1 dial selector unit at the transmitting station. The selector unit provides a momentary contact closure causing the dialed station to transmit one set of transducer readings to the receiving station. The teletype is then clear to carry other messages. A typical transmission is shown in *Fig. 2.*

*Events per unit time.

Fig. 3. Pressure transducer, which has frequency outputs proportional to the analogue quantity.

Where 010 is the code for the station dialed, XXX the reading of the input to the channel designated by the preceding number, 781 a test frequency which may be introduced at any channel by simple bussing on the control unit chassis. A reading of 781 indicates proper operation of the complete system. Channels which are not in use may be skipped by the transmitter.

Principle of operation

Basically, the transmitter performs three function:

1. Converts analogue quantities to a frequency suitable for events-per-unit-time measurement (EPUT).
2. Automatically samples converted quantities in a selectable sequence and measures them to a high degree of accuracy.
3. Translates these measurements into a suitable transmission form and transmits over existing Bell System (60 speed) teletype circuits to one or several teletypes on an "as call for" basis.

A diagrammatic representation of the transmitter is shown in *Fig.* 7 and describes the main circuit components.

Analogue-to-digital conversion

Any analogue quantity that can be converted to a frequency can be telemetered with the standard transmitter. Three basic quantities, differential pressure, temperature, and rpm will be described.

For pressures and temperatures, standard transducers are manufactured which have frequency outputs proportional to the analogue quantity. Byron Jackson Co., Pasadena, Calif., manufactures the Vibrotron *(Fig. 3)*, which is based on the principle that the frequency of oscillation of a wire will change with the applied tension on the wire. A diaphragm is used to vary this tension with changes in differential or static pressure. The mountings for the wire are temperature compensated and thus temperature variations do not seriously affect the accuracy. For the temperature Vibrotron the wire mounts are not temperature compensated and changes in tension are achieved. The vibrating wire is stretched in a magnetic field and driven by a feedback amplifier to achieve the change in output frequency. Although the curve for output frequency versus applied pressure is non-linear, a small portion of the curve can be chosen and yet retain good resolution in order to achieve linearity to errors of less than 0.1%.

The stability of the Vibrotron, equivalent to a tuned fork oscillator, is ideal for any accurate measurements. Because an initial tension is required for this principle, the output frequency decreases with increased pressure. In the automatic teletype transmitting system the output frequency is heterodyned with a standard crystal frequency to obtain an increasing frequency with increasing pressure. As an example, a static gauge was used for the range 550 to 950 psi. The output frequency of 9450 to 9150 was heterodyned with 10,000 cps to achieve a frequency to feed into the events-per-unit-time meter of from 550 to 950 cps, which provides a direct indication on the teletype record. Direct digital indications were also obtained for differential pressure and temperature. The installation now installed is giving consistant accuracies to 0.13% for all static pressure recordings.

Datran Engineering Inc. manufactures standard transducers also suitable for this system. Frequency outputs proportional to pressure are obtained by using a thin diaphragm to vary an iron core in a coil and thus change the in-

ductance of an inductance-controlled oscillator. Stabilities to one part in 10^4 can be achieved along with zero and full scale adjustments to obtain overall accuracies to $\pm 0.5\%$.

The future outlook for the above transducers is promising as more experience in industrial application is gained. One particularly promising feature is the use of a special differential transducer to provide output frequencies directly proportional to flow rate. Such a transducer when used in this system could achieve direct indications in flow rate and total flow, thus eliminating the need for taking the square root. Integration for flow rate is accomplished by the EPUT meter.

For rpm, standard tachometer generators *(Fig. 4)* are manufactured which supply a number of pulses per revolution of the shaft to be measured. An example of such a unit is the Model 461X explosion-proof tachometer generator manufactured by Berkeley Division of Beckman. This unit uses a multi-toothed gear and a magnetic pickup, which generates a pulse each time a tooth passes the pickup unit. Direct indication in rpm is achieved by generating 60 pulses per revolution, which multiplies the rpm by 60. These incoming pulses are sampled for a precise one second by the EPUT meter, which effectively divides the rpm by 60, thus achieving a direct indication on the printed teletype record in rpm.

With minor modification to the standard transmitter other analogue quantities such as shaft position or linear position may also be telemetered.

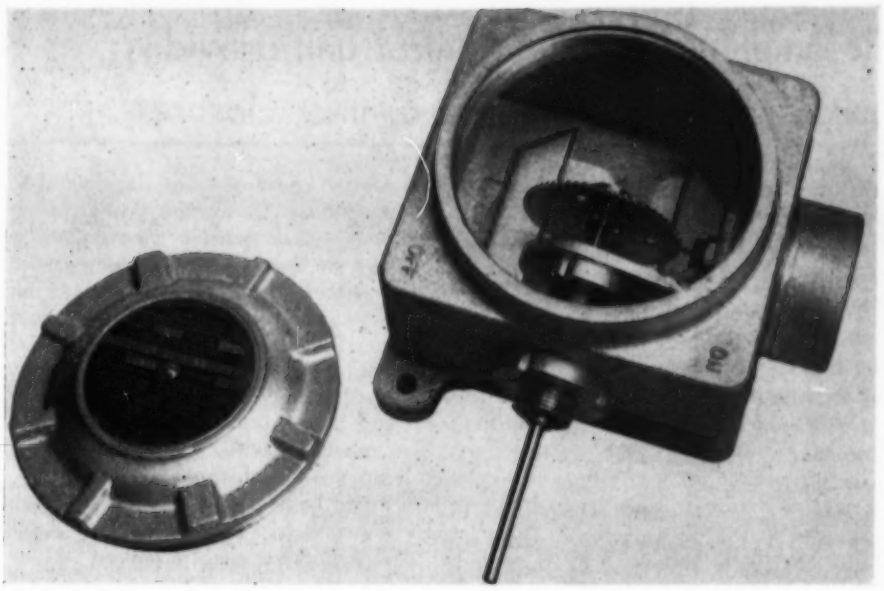


Fig. 4. RPM transducer, supplying a number of pulses per revolution of the shaft to be measured.

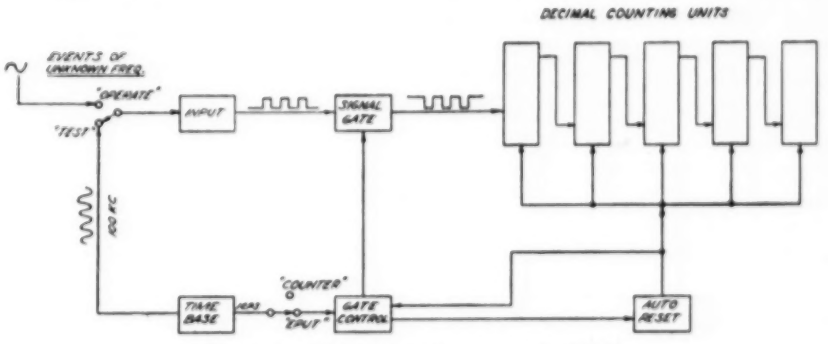


Fig. 5. Simplified block diagram of the EPUT.

Measurement of digital data

To obtain an accurate measurement of frequency a high-speed electronic counter combined with accurate, crystal-controlled timing gate is used. Such a unit, commonly called an EPUT meter, is used in this transmitter and will automatically count and display in decimal form any number of events from 0 to 100,000 which have occurred during a precise one-second counting interval. A simplified block diagram of the EPUT is given in *Fig. 5*. The EPUT consists of an input circuit, a time base, a gating circuit (including a signal gate and a gate control), an automatic reset, and five decimal counting units (DCU's). The DCU is a direct-reading, plug-in electronic counter with facilities for extracting information from the DCU to operate other electronic devices. The number of counts received is indicated by the illumination of one of 10 neon lamps placed behind a numbered acetate panel. Each unit counts from zero to nine, the 10th pulse resetting the counter to zero and simultaneously generating an output signal. The basic circuit of the DCU is a modification of the Eccles-Jordan trigger circuit with two stable states, referred to as a binary. Four binaries are connected in cascade forming a scale-of-16, which is permuted to a scale-of-10 by two resistor capacitor "feedback" networks.

Frequency outputs from transducers are amplified and shaped by the input circuit. These pulses are admitted through the electronic gate to three counting units. The gate is opened by a signal from the time base, held open for an accurately controlled time interval, and closed by a second signal from the time base. The number of pulses occurring during the time interval, which directly corresponds to rpm, psi, or °F, are displayed on the illuminated panel of the DCU's. In addition to the signal input, a test frequency of 781.25 cps is provided to indicate correct operation of the complete system.

Transmission

The transmitting element of this system is a 14W transmitter distributor manufactured by Teletype Corp., Chicago. The distributor, which normally transmits from punched tape, has been made suitable for transmission from relay-supplied information. The chassis-mounted distributor is shown in *Fig. 6*.

The distributor consists of an inner conducting ring insulated from an outer ring made up to seven insulated conducting segments. A synchronous motor drives a set of brushes around the rings so that contact is made between the inner ring and each of the outer segments in sequence. The inner ring is connected to one teletype transmission wire. The segment labeled *stop* is connected to the second teletype wire. Therefore a contact is made between the two teletype wires each time the brush passes over the *stop* segment. This accurately timed closure, together with

Telemetric control... Control unit provides necessary switching and contact closures

the open time produced by the *start* segment, synchronizes remote teletype receiver with the transmitter by stopping a similar set of receiver brushes during the time that the transmitter brush is passing over the *stop* segment. A figure is transmitted each time the brushes make one revolution. The figure to be transmitted is coded on the transmitter by connecting particular segments to one teletype line.

These coded segments are labeled 1 through 5. For example, the letter "y" has the code 1, 3, 5. To transmit this letter, segments 1, 3, and 5 would be connected to the teletype line as the brush crossed the *stop* and *start* segments. These connections would be held as the brushes crossed the five code segments and disconnected when the *stop* segment was reached. The resulting sequence of closures between the teletype lines would cause the receiver to print the letter "y."

To transmit a set of data the system performs the following functions:

1. The transmitter motor is energized.
2. A connection is broken between teletype lines as the brushes pass over the STOP segment.
3. Segment connections are made for the first code to be transmitted before the brushes pass the START segment. These connections are held while the brush crosses the five code segments. The connections then change to code the following figure to be transmitted as the brush again crosses STOP and START.
4. Transmission stops while the EPUT meter is counting the next reading to be transmitted. During this time a connection is made between teletype lines to hold the receiver in an acceptable standby condition. The closing and opening of this contact must occur as the brushes cross the STOP segment. Otherwise the receiver brushes would not start out in correct synchronism with the transmitter brushes and several incorrect figures would be received before the receiver would resynchronize with the transmitter.
5. At the end of transmission a connection is made between teletype lines and the transmitter motor is stopped.

As previously mentioned, the DCUs used each provide a four-line code output to represent its stored count. Each output wire will be at one of two distinct voltages. For example, on the count of 4, pins 9 and 6 are at the more positive of the two voltages.

The numbers are thus represented as a four-line code weighted 4-2-2-1 as shown below.

0 represents the more negative voltage.
1 represents the more positive voltage.

Wt.	4	2	2	1
No.	Line 1	Line 2	Line 3	Line 4
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	1	0
5	0	1	1	1
6	1	1	0	0
7	1	1	0	1
8	1	1	1	0
9	1	1	1	1

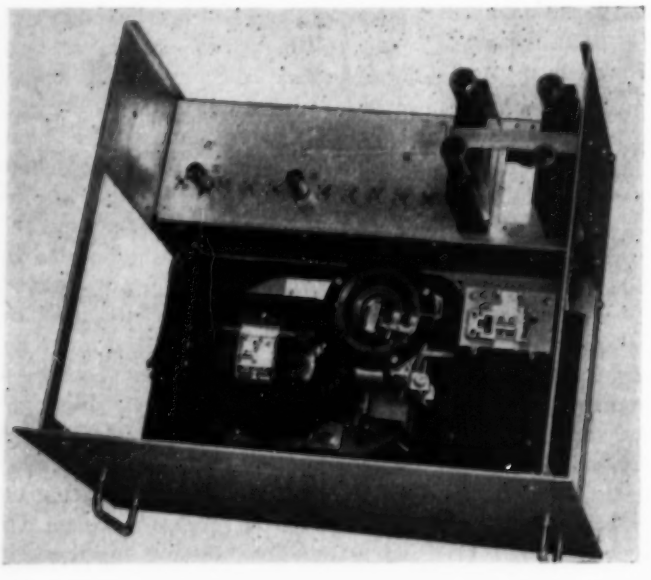


Fig. 6. Chassis-mounted transmitter-distributor.

This four-line code is converted to the five-line teletype code by a system of relays designated in *Fig. 7* as "Decoding Relays." The teletype code is given below.

0 represents an open segment.
1 represents a segment connected to the teletype line.

No.	Seg. 1	Seg. 2	Seg. 3	Seg. 4	Seg. 5
0	0	1	1	0	1
1	1	1	1	0	1
2	1	1	0	0	0
3	1	0	0	0	0
4	0	1	0	1	0
5	0	0	0	0	1
6	1	0	1	0	1
7	1	1	1	0	0
8	0	1	1	0	0
9	0	0	0	1	1

In addition to the indication on the EPUT, a station code, channel codes, and teletype received function signals are transmitted. This is accomplished by the use of stepping switches and relays which make the proper connections between the outer segments and the inner conducting ring of the distributor.

Control

Fig. 7 describes the functions of the main circuit components. Components on a particular chassis are grouped together. The control unit provides the necessary switching and contact closures for coding and operating the transmitter distributor. This switching is achieved by four stepping switches whose sequence of stepping is determined by the control circuitry.

Stepping switch No. 1 steps from home to position No. 1 as the teletype distributor brush is contacting the *stop* segment. The teletype line short provided by the stepping switch off normal contact is broken and the teletype line is then only shorted by the *stop* segment of the distributor and becomes open when the brush reaches the *start* segment. Breaking the short between teletype lines causes the remote teletype receiver to start in synchronism with the transmitter distributor.

Each time the distributor brush passes over the *stop* segment, stepping switch No. 1 advances one position to change the code on the segments. Therefore, as the stepping switch advances through 10 positions, 10 codes are transmitted. The codes transmitted by a stepping switch are indicated in *Fig. 7*. Stepping switch No. 1 transmits figure shift, carriage return, three line feeds, a three-figure station code, and one space.

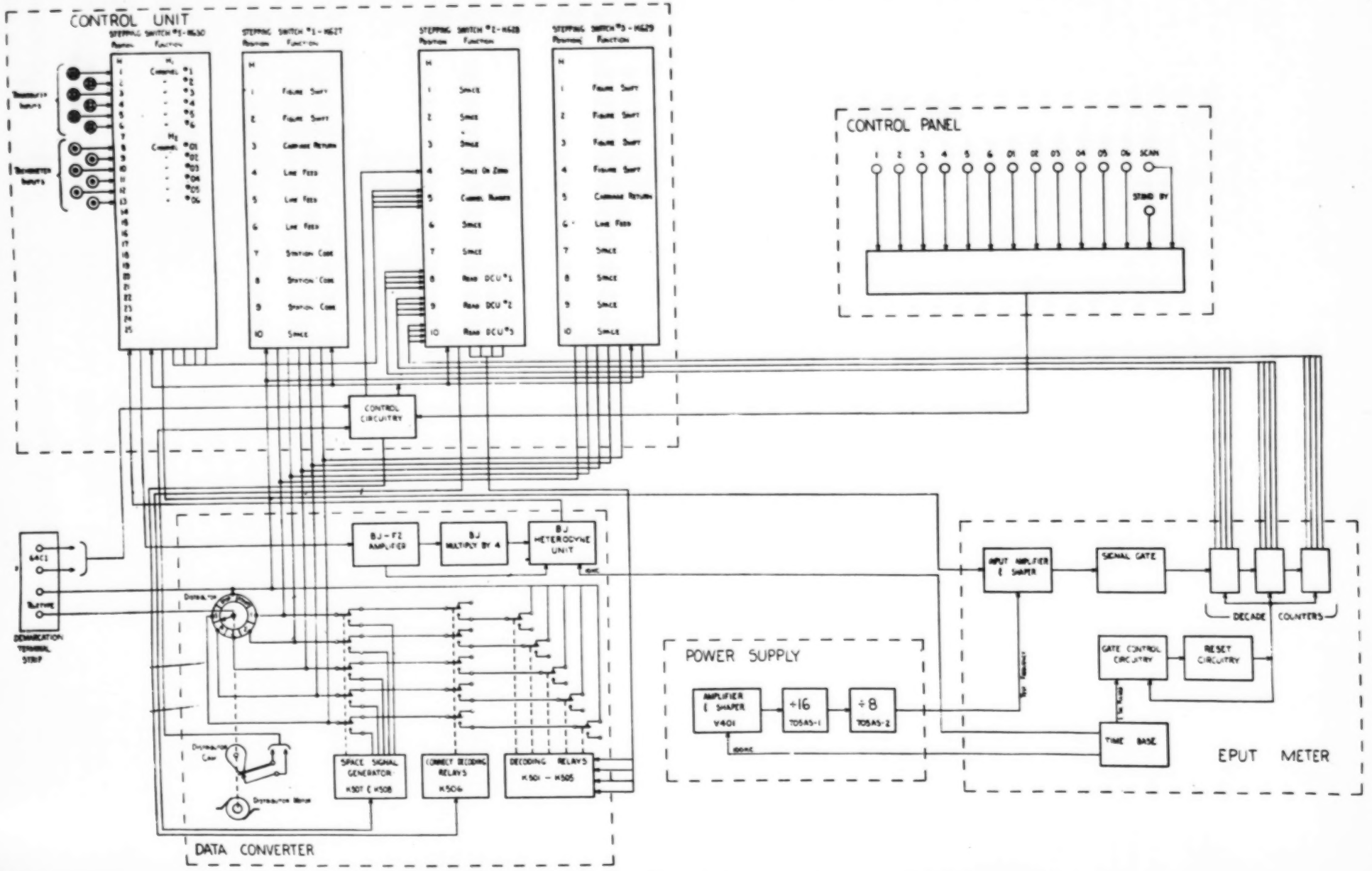


Fig. 7. Diagrammatic representation of the transmitter, describing the functions of the main circuit components.

Telemetric control... Complete testing features are provided at the transmitter site

The station code may be changed if desired by changing bussed connections on the control unit rear lip. When stepping switch No. 1 reaches its home position, the teletype lines are shorted, stopping the receiver. Stepping switch No. 5 steps to its first position, connecting the first transducer, channel No. 1, to amplifier and heterodyne units on the data converted chassis. Output of these is a frequency whose value in cycles per second is equal to the transducer reading. This frequency is connected to the EPUT meter input. The interrupter contact on this switch momentarily disconnects the EPUT meter reset buss from ground, resetting the meter and causing it to count its input frequency. The EPUT meter completes its counting period and indicates the channel No. 1 reading. Stepping switch No. 2 then steps through its 10 positions transmitting 10 codes by a similar action as was described for stepping switch No. 1. Codes transmitted are three spaces and the channel number, followed by two spaces and the EPUT reading. Stepping switch No. 1 always transmits the same code for a particular position so that codes are in the form of simple connections on the switch contacts. Stepping switch No. 2 transmits variables so that more complicated coding circuitry is required. *Fig. 7* indicates the sources of coding of stepping switch No. 2.

The space codes originate from the space code generator, consisting of two relays in series. When these relays are energized, their contacts disconnect the transmitter segments from other circuitry and reconnect them to generate the space code. These relays are controlled by one bank of stepping switch No. 2, and are energized when the stepping switch bank makes a ground connection. The three-digit transducer reading is indicated by neon lights on the DCU's. When stepping switch No. 2 is in its eighth position, it connects the four code wires from DCU No. 1 to the decoding relays, and energizes a relay to connect the decoding relays to the distributor segments. Therefore the first DCU reading is transmitted when the switch is in position 8. Similarly, the second two DCU reading are transmitted at positions 9 and 10.

The channel numbers are coded onto four banks of stepping switch No. 5 in the form of the four-line DCU code. When stepping switch No. 2 is in position 5, these four stepping switch banks are connected to the decoding relays. The decoder then codes the distributor segments with the number of the channel to which stepping switch No. 5 is switching the EPUT meter. Position 4 of stepping switch No. 2 is coded to print 0. This 0 is not printed for the first six transducers because the space code generator is energized in this position.

In stepping through its 10 positions, stepping switch No. 2 has transmitted the channel number and reading for the transducer. When this switch steps from the 10th position to the home position, stepping switch No. 5 advances, switching the EPUT input to the next channel to be read. The EPUT meter then cycles and displays the reading of its input. Stepping switch No. 2 then steps through its 10 positions, transmitting the second set of data. This action continues until headings of the first six transducers have been transmitted. Then stepping switch No. 5 advances to a position designated H2 where no input is switched to the EPUT. Stepping switch No. 3 then steps through its 10 positions transmitting 10 codes as did stepping switch No. 1. These transmissions are carriage return, line feed, and space codes to position the receiver carriage for typing the second line. Stepping switch 3 and 5 then transmit the second line of readings by the same action as followed to transmit the first line. Stepping switch No. 5 may be made to skip any channel not used. Which channel will be skipped is determined by changeable busses on the control unit chassis. When a transmission is complete, the stepping switches return home and the transmitter distributor motor is de-energized.

The instrument may be made to transmit a test reading in place of any one of the channel readings by making buss connections on the control unit chassis. The test reading is derived in the following manner: A 100-kc frequency is conducted from a crystal controlled oscillator in the EPUT time base to the amplifier chassis where it is divided by seven binaries. Output frequency of the binaries is then $100,000/2^7 = 781.25$ cycles per second. This frequency is read by the EPUT meter to give the test indication, which should indicate as 781 or 782. A reading other than these indicates malfunctioning of this system.

As we have pointed out, transmitting is completely automatic, requiring no manual operation other than dialing the transmitter. However, in order to provide minimum maintenance, complete testing features are provided at the transmitter. The control panel is used for manual operation at the transmitter site.

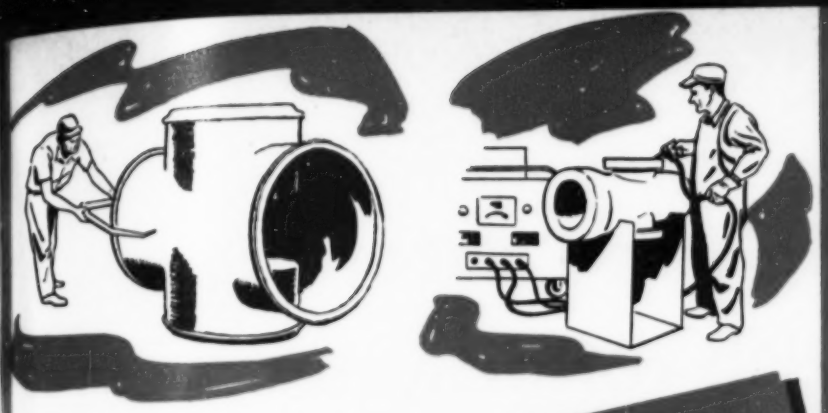
The test channel buttons on this panel are numbered to correspond with each of the input channels. When one of these buttons is depressed the EPUT meter will be switched to the corresponding transducer. Indication on the EPUT is the pressure, temperature, or rpm reading of that transducer. The EPUT will continue to count and display the transducer reading until another button is depressed, or the station is dialed. Depressing the test scan button causes the instrument to go through its normal transmitting cycle. However, the teletype output is shorted so that no transmission takes place. This function may be used to check operation or to read the transducer data of all inputs in time sequence.

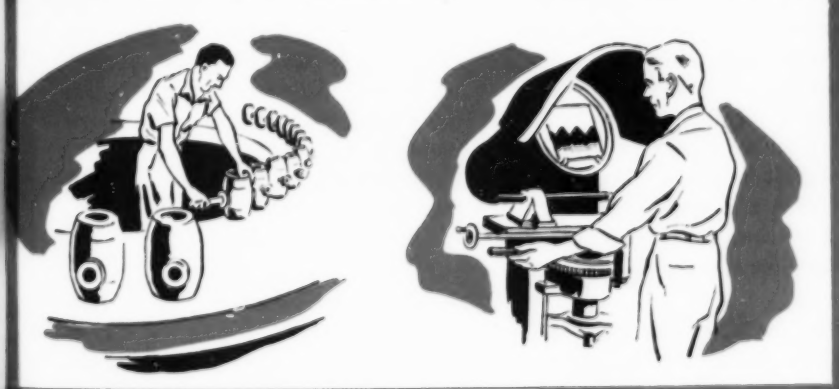
Any function produced by depressing the control panel buttons is interrupted when the station is dialed and transmission will immediately take place. During transmission all control panel buttons are disabled to prevent accidental interference with transmission.

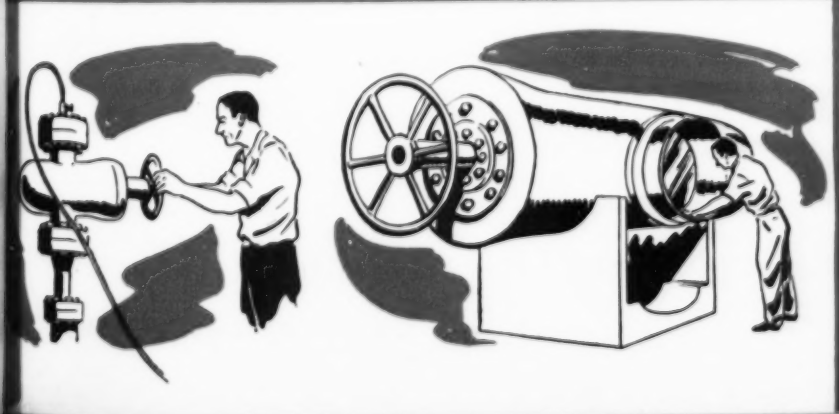
Complete tests on the first complete system installation indicate the following:

1. Direct digital indications on standard teletype paper at any remote location.
2. Accuracies to $\pm 0.1\%$ are possible for pressure, temperature and rpm.
3. Transmission times as low as 45 seconds can be obtained for transmission of 12 measurements including all codes.
4. Low cost, long distance transmission can be provided.
5. Automatic check of all electronic circuits during each transmission ensures a reliable industrial system.

The experience gained by this installation should prove invaluable for both similar applications and the new different applications which have appeared as a result of this initial installation. ■







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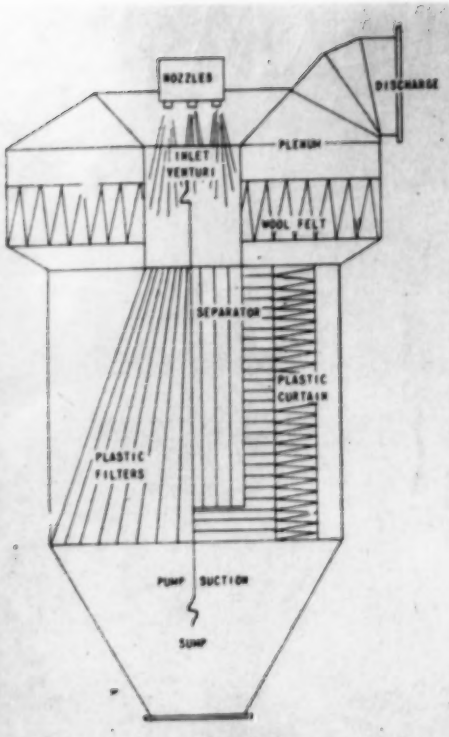

Fighting detonation with conditioned, scavenged air

By F. R. CRAMER • Southern Counties Gas Co., Los Angeles

Fig. 1. High capacity evaporative cooler which proved to be remarkably efficient for cooling air stream and eliminating detonation problem in the engine that it served.

WE HAD experienced detonation in large two-cycle gas engines during periods when they were operating under maximum load while ambient temperatures exceeded normal acceptance test conditions. This problem led us to investigate the work that was being done about two years ago concerning the application of cooling for conditioning scavenging air to alleviate detonation in this type of engine.

With the assistance of others, a high-capacity evaporative cooler was developed *(Fig. 1)* and tests indicated that it was remarkably efficient for cooling the air stream and completely eliminated the detonation problem in the engine that it served. However, while the evaporative cooler solved the detonation problem, it produced severe corrosion because the unit was engineered to operate exclusively on water for its filtering and cooling, and the mixing of air and water produced an ultimate corrosive condition.

From this experience, we knew that we should use the evaporative cooler only when it was essential for preventing detonation, but we still needed a device that would give us this required cooling during this period and, at the same time, provide adequate filtering during spring, fall, and winter months. About this time, we learned that a major filter manufacturer had announced results of preliminary tests with a combination oil filter-evaporative cooling unit, so we decided to investigate its ability to fill our need.

This machine *(Fig. 2)* was a dual purpose filter having the unique and desirable capacity of being operable on either oil or oil-water cycle. The company's conventional "cyclonic" oil filter had been fitted with an extended case, which housed a separate pair of pads, and provision for the application of water, using the same general principle as that provided for the oil side. Transfer from use as a "dry" filter to a combination filter and cooler was accomplished simply by turning the water off or on.

At the beginning of the 1954 summer "ping" season, a cycoil unit was installed on one of our Clark BA8 1600-hp engines adjacent to the original evaporative cooler installation, and for the purpose of comparative analysis, both it and the original machine were operated concurrently at identical conditions. Considerable latitude was granted us by the manufacturer both in method of operation and those minor changes that were incorporated in the machine to better serve our test requirements. Our experience with the original cooler had provided us with all the significant aspects of a completely comprehensive trial, and during the series of 24-hour tests, every measurable condition of the two operating engines was observed and recorded.

At the time of our original tests, approach to wet bulb had been accepted as the universal index of cooler efficiency, and we knew that we had a unit of superior performance by that standard. Historically, then, our performance was measured by the relation of cooling efficiency to final airstream temperature. The inspection plate nearest the combustion chamber of the most remote power cylinder was selected as the optimum temperature point.

During our test on the original installation, we found that in all cases except one the relation of cooling efficiency to final airstream temperature was uniform, and we constructed a curve based on this correlation as an exhibit to supplement the test data used in the study of various combinations of pump sizes, fans, etc. *(Fig. 3)*. In the one exception, the alien figures were considered in error, and were deleted from the test data. The phenomena, however, were not disregarded, and we immediately began an analysis of the

This article is adapted from a talk presented at the PCGA transmission conference held in Palm Springs recently.

sketchy and meager accumulation of figures that we had taken during the tests. In all cases where we had sufficient data, we were able to determine that the relation of *moisture content* to final temperature was considerably more uniform than was cooling efficiency to final temperature.

Admittedly, the cooling efficiency of the filter would have a direct relation to the moisture content insofar as atmospheric condition would present approach potential. In the case in question, we had a particularly humid night, the moisture content per pound of dry air was high, and the ambient such that evaporation and coincidental cooling were at a minimum.

We then superposed on the cooling-efficiency-vs.-final-temperature curve another curve derived from the same figures but based on moisture content vs. final temperature. This curve, for all practical purposes, described a straight line.

We reviewed the two rejected temperatures and found that they, too, bisected the moisture-content-vs.-final-temperature curve. Appended to the cooling-efficiency-vs.-final-temperature curve is an extension derived from the truant temperature. Obviously, if we accepted this temperature, then the original curve as a means of correlation was of no further significance. The moisture content relation, however, appeared to be quite conclusive, and all subsequent test data "blipped" this curve.

The first parallel tests were made on June 16, 1954, and the results are shown in *Tables 1* and *2*. The original evaporative cooler-filter still retained its remarkable approach capacity. Paradoxically, however, the new unit in which we were experiencing comparatively poor performance as an evaporative cooler showed uniformly lower temperatures of the airstream, both in the butterfly compartments and the cylinder intake ports. This was our first clue to the suppression of detonation by controlled moisture content without regard to temperature depression. Of even more significance, from these preliminary data, it appeared that for the first time we were showing a measurable difference in Btu/bhp/hr.

Introduction of moisture in the evaporative cooler was completely dependent on the evaporative capacity of the cooling unit. From this it was evident that where induced moisture content was a factor of evaporation, consistently measurable difference in fuel efficiency would be contingent upon natural atmospheric condition.

Practically every article that we had reviewed concerning the experiences of others in their observations of combustion air cooling had been prefaced by a paragraph extolling the unusual improvement in engine performance while driving their cars either along the coast in the fog or in the rain. From this postulate the parallel of evaporative cooling was woven into the plot, and developed into a conclusion of figures, charts and miscellaneous propositions which might or might not apply to another's problems.

A more appropriate analogy would be the gimmick salesman who lurks on the street corner with his little mayonnaise jar and complex looking tubing with which he is able to make your car, whether Cad or clunk, respond as if it had just received a hormone injection. When, and if, the natural moisture content of the local atmosphere approximates that which his "goldberg" can produce, he closes up shop and hies himself to higher, dryer and greener pastures—leaving his customers wondering what happened.

This, in effect, is what our tests indicated we were experiencing in our attempts at evaporative cooling.

The quantity of moisture admitted to the combination unit was measured against the runoff from the drain, and the net moisture applied to the scavenging stream approximated. Where the net application had been a factor of evaporation in the case of the evaporative filter, we found that varying humidity and consequent approach potential made little, if any, difference in the net use induced into the air stream of the combination unit. There was no question now that we were applying moisture as finely distributed droplets of water rather than in evaporated state.

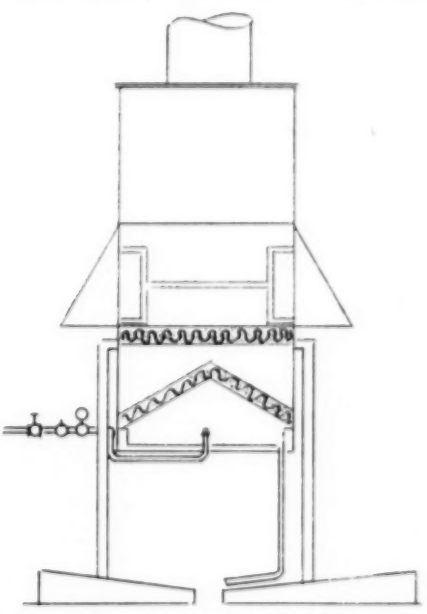

Fig. 2. Combination oil filter-evaporative cooling unit operable on oil or oil-water cycle.

Since this test substantiated our idea that detonation could be suppressed by the addition of a small controlled quantity of moisture, our next concern was to establish that we were not jeopardizing the equipment by its use.

If the change of state was occurring in and after the compression cycle of the scavenging cylinder, where were the mineral components of the evaporated water collecting? Were they being deposited in the scavenging equipment, or were they being carried by the air stream to the combustion chamber and ultimately out with the exhaust gases? Meticulous inspection of the scavenging equipment as well as the route of the air stream and the piston heads and walls of the power cylinders disclosed no unusual appearance, so it was presumed that no serious consequence should result.

Having established that the new equipment was certainly not an evaporative cooler in the sense of the original machine, there was little purpose in any elaborate construction to provide simple moisture application.

At this point, one of the atomizing spray nozzles was interposed in the plenum chamber outlet of one of the conventional curtain type air filters, and a simple arrangement for recovery of any excess moisture was built into the filter base.

Tests were then conducted for 24 hours using this type application vs. the efficient evaporative cooler-equipped engine, and again we were able to measure a substantial difference in final temperature depression.

Examination of *Table 2* indicates that in the case of the combination unit the airstream temperature bisected the evaporative filter stream temperature at somewhat less than the temperature required for change of state at the elevated pressure. This difference then increased as the airstreams progressed through the areas of flash temperature.

From this it was apparent that change of state was occurring in most cases within the scavenging manifold and that we could expect the equivalent of

an increase in manifold pressure which would serve to more efficiently scavenge the cylinders and also have a cooling effect on the internal walls.

In aircraft, the use of rich mixtures was found to spread the burning time and reduce the high temperatures sufficiently to prevent autoignition and detonation. Similar results were produced by the injection of water and water-alcohol mixtures. Either method tended to fatten the upper portion of the indicator diagram with reflected increase of bmep.

Additional studies indicated that at elevated temperatures dissociation of steam occurred and was characterized by "reabsorption" of thermal energy.[1] As the temperatures increased, a chemical equilibrium was reached wherein the dissociation equalled the burning reaction and no further increase of temperature obtained. Then, as the expansion stroke increased the volume in the cylinder, and therefore reduced the pressure and temperature, dissociation was arrested and reaction completed. This delay was shown to maintain a higher uniform pressure during the expansion stroke and so add to the work done.

Similarly, it had been established that the cooling effect of the water in the mixture during the compression stroke produced a reduction in the work of compression as high as 10 or 12%, which would also be reflected in increased net power output.[2]

The phenomenon of dissociation was of particular interest in our experiments since, according to the Rowe and Ladd studies, "it does not appear to matter whether the water enters the cycle as either a vapor or a liquid." Admittedly, latent heat would not be available in the vapor.

Review of the various attempts to condition scavenging air disclosed a variety of opinions, both in purpose as well as method. Originally, our problem was attributed to the marginal air excess at design condition. This minimum excess design was believed to produce insufficient air and resultant detonation during high ambients and top load conditions. Since redesign of the scavenging capacity was impracticable, air cooling to increase density was the obvious answer to our problem, and all efforts were directed to that end.

Later engines by this same manufacturer incorporated an increase in scavenging air capacity. However, the compression was increased materially at the same time so that any attempt to isolate the reason for absence of detonation would have to consider the inherently cooler operation at higher compression as well as the cooling provided by increased excess air.

In the case of the evaporative cooler, the heat of evaporation is extracted from the inlet air and surroundings to produce cooling of the air stream. The cooled air and its evaporated moisture then enters the scavenging compressor and equipment and is subjected to the heat of the engine, and is responsive in the same ratio as if the moisture content had been a natural condition of the inlet atmosphere.

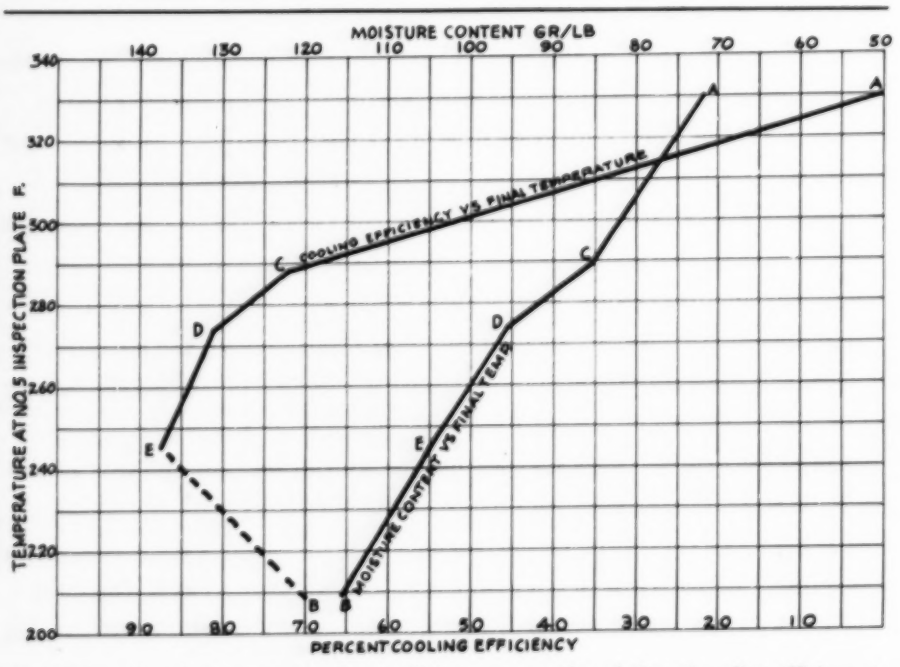

Fig. 3. Curve based on correlation that in all but one case the relation of cooling efficiency to final airstream temperature was uniform.

If this same moisture was entrained as a finely divided mist in the air stream after compression, all the latent heat would be available for heat abstraction by change of state in the critical zone.

Another engine company which has done extensive field work in air cooling experiments originally attached a redwood tower to a conventional curtain-type oil maze air filter; later, the circulating water was introduced into a closed exchanger placed in the scavenging air stream to operate as an after-cooler. More recently, an additional provision for moisture application was designed into the air stream after the compression cycle, and the company representative now maintains that this is the "ultimate in truly conditioned air."[3] From our experience, we would be inclined to subscribe to this theory since our tests indicated that the suppression of detonation by evaporative cooling in our particular case was closely identified with moisture content, and whether the moisture was inspired by evaporation or resident in the natural atmosphere, the final temperatures of the air stream were directly affected in ratio to that moisture content.

The theory of moisture content has been challenged by information from areas where detonation is common and humidities generally high. Several explanations have been offered, the most accepted concerning probable difference in the quality of the fuel gas. Actually, it is possible to demonstrate conditions of extreme humidity with moisture content comparable to that at which we experienced detonation in the desert area. Assume an engine operating at normal full load and at the following conditions in which 6250 cfm air is being inspired by the scavenging equipment:

	A	B
Dry bulb ° F	80	115
Wet bulb ° F	75	85
R.H. %	80	30
Moisture content Gr/lb	122	134
Specific volume cf/lb	14.0	14.9
Air lb/min.	446.0	420.0
Moisture content lb/min.	7.8	8.0

We would expect to experience detonation at condition "B".

This is not proposed as a cure-all for the detonation problem in humid areas, but rather as a possible explanation of apparent inconsistency in the value of moisture to suppress detonation.

Evaporative capacity at conditions "A", either for the purpose of air cool-

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Fighting detonation... Cylinder tests showed measurable difference in fuel efficiency would be contingent upon natural atmospheric condition.

TABLE 1. SCAVENGING AIR TEMPERATURE TESTS

(June 16, 17, 1954)

Annis air filter				N									M											
Number 6	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8
Dry bulb temperature	94	96	96	101	101	102	102	104	102	98	95	94	93	89	88	84	87	84	79	79	74	68	80	91
Filter intake	96	98	97	101	97	104	101	106	106	104	103	95	93	93	93	86	85	76	80	79	74	74	78	92
Plenum chamber	72	73	74	76	75	77	76	78	77	77	76	74	72	71	71	70	66	64	65	65	64	64	68	71
Wet bulb temperature	65	66	66	68	67	68	69	70	69	69	69	68	66	65	65	64	64	62	62	62	60	62	66	66
Efficiency percent (FI-PC/FI-WB)	77	78	74	76	73	75	78	90	81	80	80	78	78	78	78	73	90	86	83	88	72	83	83	71
No. 2. Scavenger discharge	135	137	138	140	140	142	142	142	142	142	141	140	139	138	137	137	134	133	134	134	132	132	135	136
No. 5 cylinder butterfly housing	187	191	192	194	194	195	195	192	190	193	192	199	197	196	195	196	184	182	184	184	192	194	196	188
No. 5 Inspection plate	274	276	278	282	280	280	280	280	280	278	277	290	286	282	282	281	278	278	282	282	282	284	290	270
Rate	656	651	649	654	655	655	656	656	653	651	654	656	655	655	654	654	653	654	656	655	654	654	655	655
Horsepower	1624	1628	1638	1648	1644	1644	1638	1620	1606	1606	1600	1676	1670	1665	1661	1658	1651	1660	1661	1661	1661	1662	1680	1540
Btu/bhp/hr	10224	9296	9707	10096	10151	10202	9946	9819	10082	10151	10140	9856	10167	10282	10083	9995	10095	10607	10405	10259	10556	10162	10315	10968

MISCELLANEOUS DATA

Average rpm	300	Average plenum pressure H20 in. (20 in. duct)	—1.25
Average horsepower	1643	Average scavenger air manifold press. hg. in.	6.75
Average Btu/bhp/hr	10,050	Hours since last overhaul	8394

TABLE 2. SCAVENGING AIR TEMPERATURE TESTS

(June 16, 17, 1954)

Cycoil air filter				N									M											
Number 5	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8
Dry bulb temperature	94	96	96	101	101	102	102	104	102	98	95	94	93	89	88	84	87	84	79	79	74	68	80	91
Filter intake	95	98	99	100	102	102	102	99	100	97	100	96	94	95	91	90	86	82	90	90	80	78	88	94
Plenum chamber	89	90	88	89	90	92	92	91	91	89	88	85	83	81	80	79	77	74	75	75	72	70	76	81
Wet bulb temperature	65	66	66	68	67	68	69	70	69	69	69	68	66	65	65	64	64	62	62	62	60	62	66	66
Efficiency percent (FI-PC/FI-WB)	16	25	33	34	34	29	30	31	30	28	39	39	39	47	42	42	28	40	53	53	40	47	52	53
No. 2. Scavenger discharge	151	152	155	156	158	160	160	160	159	157	156	155	153	152	152	150	148	147	146	145	145	142	146	148
No. 5 cylinder butterfly housing	182	183	186	190	190	192	192	191	190	189	187	190	189	187	186	185	178	178	182	182	180	180	184	179
No. 5 Inspection plate	240	246	247	250	249	250	250	250	248	250	246	253	252	252	250	248	248	248	246	244	245	244	248	240
Rate	656	651	649	654	655	655	656	656	653	651	654	656	655	655	654	654	653	654	656	655	654	654	655	655
Horsepower	1624	1628	1638	1648	1644	1644	1638	1620	1606	1606	1600	1676	1670	1665	1661	1658	1651	1660	1661	1661	1661	1662	1680	1540
Btu/bhp/hr	9576	8690	8637	9700	9493	9558	9495	9467	9717	9717	9416	9634	9233	9795	9623	9770	9550	9759	9623	10078	10046	9650	9096	11080

MISCELLANEOUS DATA

Average rpm	300	Average plenum pressure H20 in. (20 in. duct)	—3.5
Average horsepower	1643	Average scavenger air manifold press. hg. in.	7.25
Average Btu/bhp/hr (1104)	9650	Hours since last overhaul	9258

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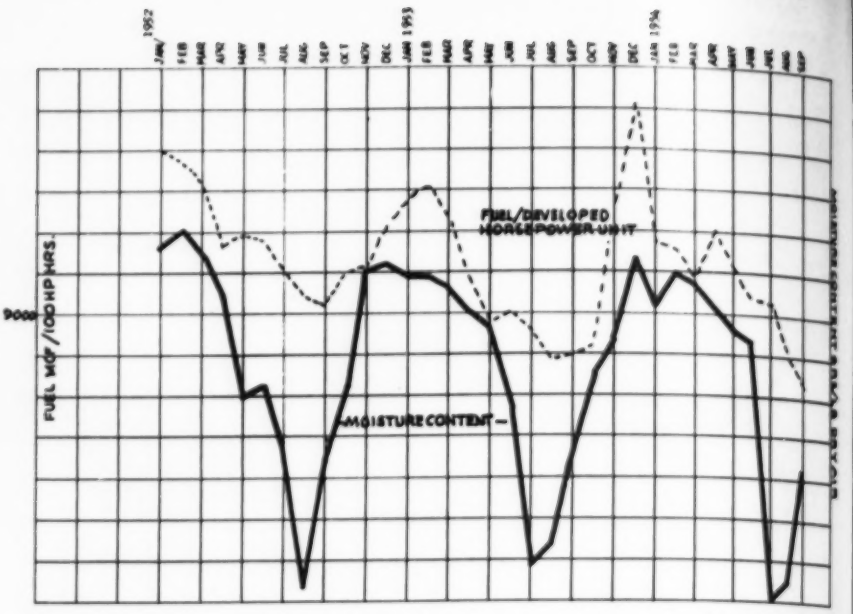

Fig. 4. Results of a three-year study of seasonal fuel use to establish relation of fuel use vs. moisture content.

ing or moisture addition, would be practically non-existent due to the high relative humidity. Mechanical refrigeration to produce the required cooling without humidification would be prohibitive in cost as outlined in several studies. Significant increase in moisture content, however, again without regard to inlet air stream temperatures, could conceivably be used to suppress detonation in this case.

Summarizing our tests, we were able to establish to our own satisfaction that we could effectively produce conditioning sufficient to prevent detonation by application of a quantity of moisture to the airstream if this value was equal to or greater than that produced by evaporation; the quantity induced would not be limited by evaporative potential of the ambient air if we injected the moisture in the stream after compression where elevated temperatures and pressures presented a greater capacity; we would experience the equivalent of an increase in manifold pressure if change of state occurred in the manifold area; and should benefit from any advantage realized by the endothermic reaction of dissociation in increased power output, irrespective of where change of state occurred.

We then duplicated a manifold inspection plate in clear plastic and equipped it with an atomizing spray head and installed it at a point on the airstream immediately below the thermometer equipment at the inlet of the combustion chamber of No. 5 cylinder.

A series of four-hour tests were made using this "panic button" vs. dry operation. Injection rate was 0.8 lb/minute. Depression of final airstream temperatures of 8 to 10° F resulted, and again the effectiveness of moisture content without regard to inlet air temperature depression was substantiated.

This summary prompted us to review the seasonal fuel use at the Blythe plant for a three-year period to establish the relation of fuel use vs. moisture content. The result of this analysis is shown in *Fig. 4*, where the fuel use has been plotted against moisture content computed from the average daily mean temperature for the 33-month period.

From this, we propose that substantial fuel savings could be effected through the use of controlled moisture application during winter operation where the problem of detonation is at a minimum.

A ½-in. copper header has been designed and equipped with eight atomizing spray heads, each of which will supply 0.5 to 1.0 lb per minute of water fog directly below the inlet of each power cylinder.

This equipment will be used to conduct further tests during which time we expect to have the engines accurately indicated with and without moisture injection.

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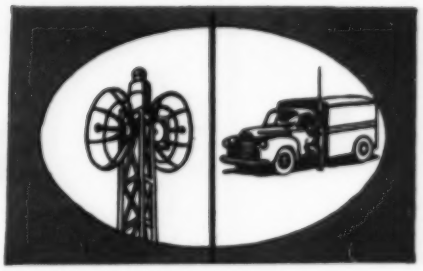


By FRANK CHAPMAN

Facsimile demonstration shows potential of microwave

IN planning and arranging for the recent demonstration* of facsimile on a gas pipeline company micrawave circuit, the editors of *GAS* had more in mind than merely to prove that a facsimile signal could be transmitted over a microwave channel, or that facsimile could be used to advantage for certain phases of a gas pipeline company's operations. As engineers we were fully aware of the technical aspects of the demonstration and acquainted with the communications requirements of a gas pipeline company's operations, and we were satisfied, long before the project was suggested, that facsimile could be transmitted over a microwave and that there would be instances where it would be of value in an operating department.

Our underlying purpose in sponsoring the project was to help the gas industry learn more about the flexibility, the capability and the dependability of microwave as a medium of communication, and to demonstrate these features in the most emphatic manner possible. Facsimile appeared as an ideal vehicle to accomplish these purposes. The circuit requirements for the transmission of facsimile are extremely severe, and any short comings in the circuit are obviously evident in the recorded copy for the appraisal of the non-technical as well as the technical observer.

Enthusiasm gratifying

It was, therefore, of considerable satfaction that those who witnessed the demonstration and inspected the recorded copy were enthusiastic in their comments on the performance of the microwave circuit.

As the industry takes more and more to the use of automatic control, or what has come to be known as "automation," microwave will be called upon to provide the linkage between the control and the controlled points. As such it becomes a vital element in the entire system of automation and must demand the confidence of those in the industry who are working with automatic control processes. It is for this reason that the potential offered by microwave as a medium for telemeter, supervisory or remote control, or any of the processes of automatic operation, must be made known to all in the industry who are thinking and planning for the industry's future operating techniques.

Confidence in microwave

The *GAS* facsimile demonstration was intended to promote the kind of industry confidence in microwave that will serve to lead to its widespread acceptance as a medium for the entire gamut of automatic control processes. The demonstration was designed to "dramatize," in effect, what has already been proven about the potentialities of microwave; that it is a medium of communication capable of satisfactorily handling any of the processes of automation.

The accuracy with which the facsimile signal was reproduced at the receiving location, as evidenced by the high degree of definition in the recorded copy, emphasized the potential application of microwave for the handling of any type of service requiring the faithful reproduction of a transmitted signal at a distant point. In the demonstration the recorded copy was judged as the equivalent of a "side-to-side" transmission or equal in definition to the maximum capability of the facsimile equipment.

Severest test

Since definition of this degree requires the exact reproduction of the transmitted frequency at the receiving point, the results of the demonstration indicate the capabilities of microwave radio insofar as it may be used for telemetric and supervisory or remote control systems that depend upon a signal frequency to carry the necessary intelligence. The requirements of a microwave channel for facsimile transmission are ordinarily more severe than those required for telemetric or supervisory control processes.

A slight change in carrier frequency from transmitter to receiver or the presence of any distortion in the circuit would have been readily evident in the recorded copy. No more severe or obvious a test of the frequency handling capabilities of a microwave channel could have been designed.

Although the dependability of microwave is now a well accepted fact, this characteristic was further emphasized in over 14 hours of transmissions during the two-day demonstration without a single momentary instance of circuit outage. Further than this there was no evidence in the recorded copy of a partial loss of signal or presence of noise.

Here again, the facsimile demonstration not only provided an extremely severe test of the dependability of a mi-

*For full coverage of facsimile test, see story beginning on page 107.

crowave channel over continuous periods of time, but it also provided a pictorial record in the received copy of the fact that there were no interruptions or noise on the circuit of sufficient consequences to alter the transmitted signal.

Auxiliary channel

The flexibility of the microwave circuit was dramatically brought out by the manner in which an auxiliary channel was inserted between two existing channels in the system to handle the facsimile transmissions without altering any of the system's other services. The facsimile demonstration would have been well worth while if it had served no other purpose than to show this outstanding flexibility of microwave.

Any medium of communication that is called upon to handle the processes of automation must offer a high degree of flexibility. This is due partly to the forward thinking of the gas industry and the fast moving development of automatic techniques A microwave system should be capable of being adapted to the use of new techniques as they are developed and put into operation.

Although it would probably not be feasible to permanently install an additional channel between two existing channels in a microwave circuit, the facsimile demonstration proved to the complete satisfaction of all who inspected the recorded copy that a high quality channel might be so created.

Flexibility shown

The flexibility of the microwave circuit was also shown by the channel arrangement that permitted all stations to receive transmissions simultaneously. The convenience of being able to so arrange channels depending upon requirements is important in an operation like that of a gas pipeline company where needs are hardly the same from day to day.

In analyzing the results of the demonstration, therefore, emphasis should be placed upon the microwave channel characteristics as evidenced in the quality of the recorded copy. Good definition, the absence of level changes and noise, as well as the overall quality of the recorded copy all serve to indicate the potentialities of microwave for services of a similar nature. ■

GAS pipeline news

FPC rules producer's rates properly rejected

A decision by a presiding examiner ruling that rate schedules filed by Cities Service Gas Producing Co. were properly rejected by the FPC's secretary as not in conformity with the commission's rules and regulations has been affirmed, with modifications, by the FPC.

On Nov. 10, the producing company, which originally filed the rate schedules last Sept. 13 which were rejected Oct. 13, asked for a rehearing, which was granted. The filings provided for increases in the company's rates to Cities Service Gas Co., its parent. Although the producing company characterized the filing as an initial rate schedule, the letter of rejection indicated that the rejected filing actually was subject to the requirements of that section of the FPC rules governing changes in rate schedules.

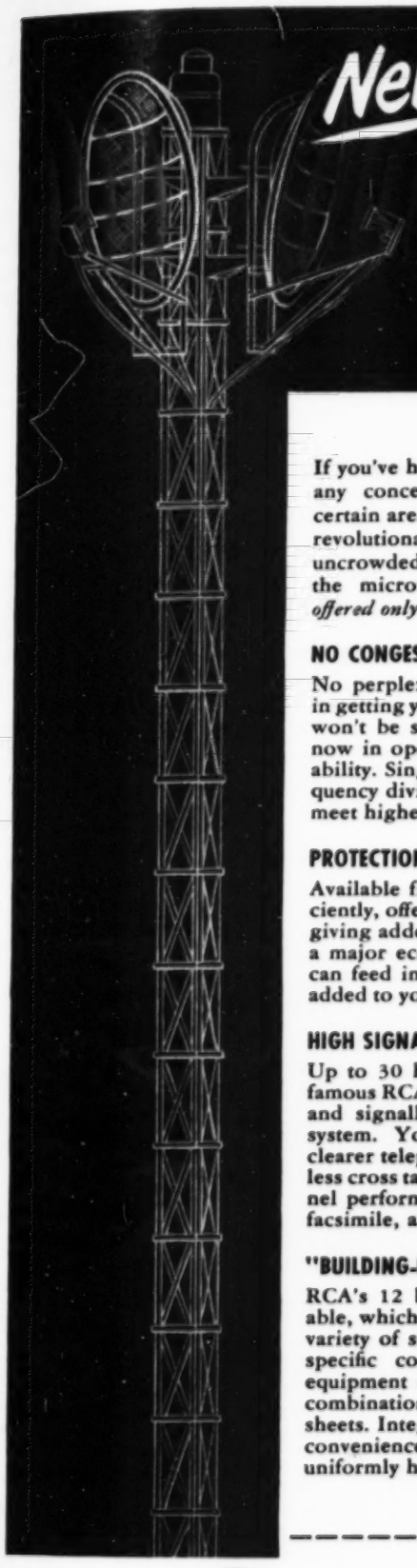
Sales are made under a 1953 contract, which provided for an initial price of 6.7961 cents/Mcf from the Panhandle field in Texas and 9.8262 cents from the Guymon-Hugoton field in Oklahoma. The FPC says the rates filed Sept. 13 provided for 10.1829 cents for the Oklahoma field and 8.2071 cents from the Panhandle field. The examiner's decision concluded that the former rates were the ones in effect June 7, 1954, the date set by the commission for its regulations to become effective governing the filing of rate schedules by independent producers.

In his concurring statement, Commissioner Digby said he has not receded from the view expressed in his dissent in connection with Order 174 and its amendments. However, he said these orders constitute the only authorized procedural regulation of independent producers in these matters "and I consider it proper to be bound by and support these orders." In his dissent to Order 174, Commissioner Digby said that the order not only would fix rates retroactively, but in many instances would have the effect of reducing producers' rates or prices that have increased under their sales contracts since June 7, 1954.

Kaiser Steel purchases Basalt Steel division

In a multi-million dollar transaction, Kaiser Steel Corp. has purchased the Steel division of Basalt Rock Co. Inc., according to Jack L. Ashby, vice president and general manager of Kaiser,

The Napa plant occupies a 75-acre site on the navigable Napa river. Two modern production lines for the manufacture of steel line pipe are located here.



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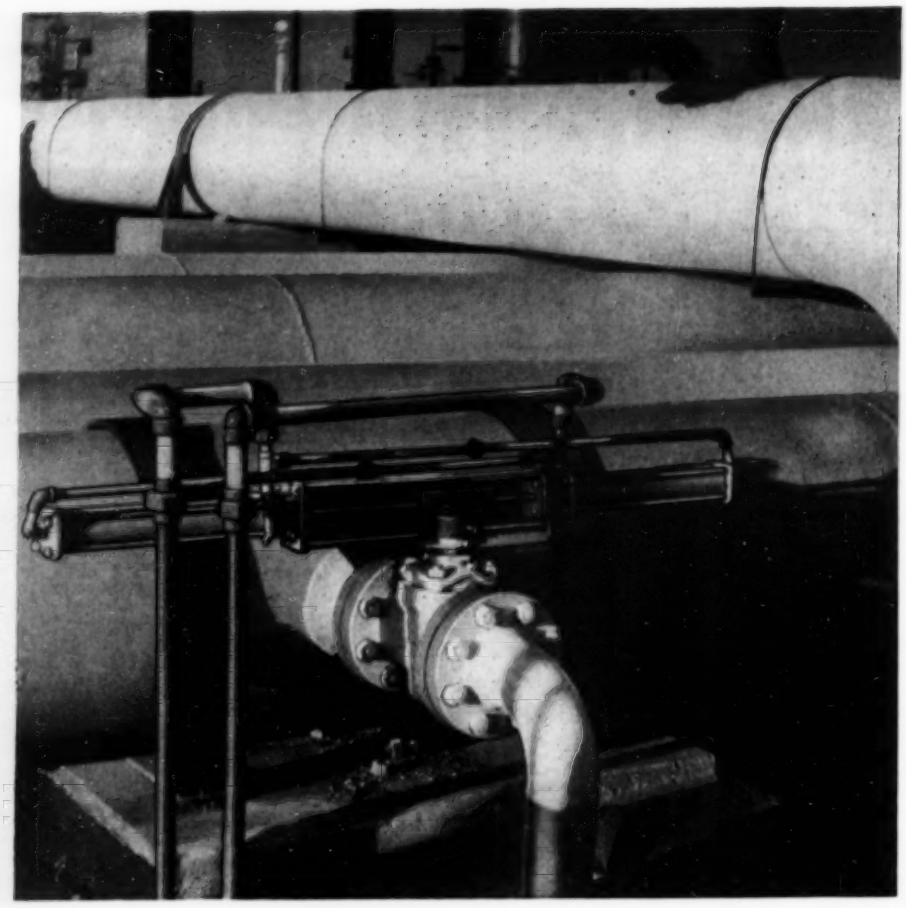

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and A. G. Streblow, president of Basalt.

The facilities consist of two modern plants, one located at Napa, Calif., near San Francisco, and the other at Fontana, near Los Angeles. Employing a total of 800 people, the plants produce large diameter expanded steel line pipe, medium diameter electric resistance weld pipe, large diameter steel reinforced concrete pipe, and a variety of steel products.

Since 1949, Basalt and Kaiser have worked closely together in a joint manufacturing-sales contractual arrangement. Basalt fabricated large diameter pipe using steel plate produced by Kaiser. The pipe was marketed nationally by Kaiser using the trade name Basalt-Kaiser. With the acquisition of Basalt Steel division, Kaiser takes over the manufacturing phase of the established steel and steel reinforced concrete pipe business, and obtains additional steel fabricating facilities.

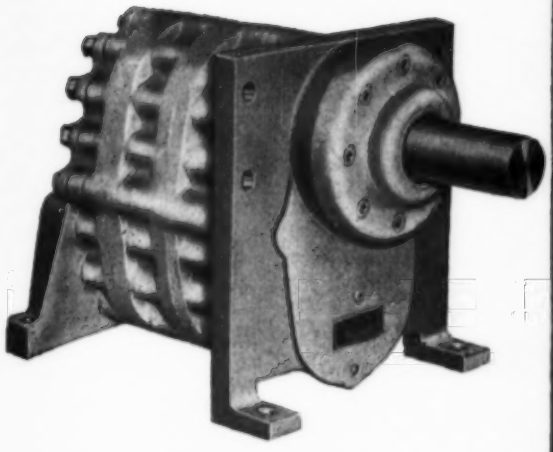
Principal installations at the Napa plant, which occupies a 75-acre site on the navigable Napa river, are two modern production lines for the manufacture of steel line pipe from 6⅝ in. to 36 in. in diameter and up to 40 ft in length. In addition, the plant has diversified equipment for the fabrication of a variety of steel products, including underground storage tanks, butane and propane tanks, bins, well casings, siphons, tunnel liners, and specialized items. It also includes four dry docks, a machine shop, and complete shipbuilding equipment.

The plant is Kaiser Steel's first production facility in the San Francisco Bay area.

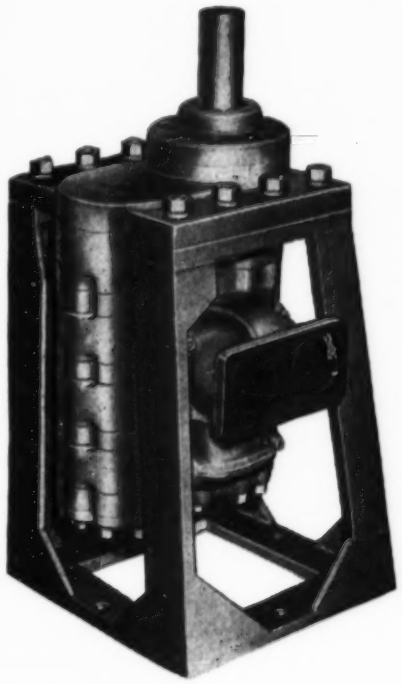
Election year may affect bill passage in 1956

Shortly after the House passed the natural gas bill exempting producers from general jurisdiction of the FPC, Senator Daniel (D.-Texas) predicted that the bill will get Senate and presidential approval by Feb. 15 of next year.

However, opposition from consumer interests is expected to become more vocal during the coming months. Hanging over its passage is the threat of filibuster from a group of "pro-consumer" senators, headed by Senators Douglas, Kefauver, Morse, and Humphrey. Some sources believe that because 1956 will be a presidential election year, self-appointed champions of "public interest" could use the filibuster threat to scare the Senate leadership of both parties if it is used aggressively.



THE BERRY PUMP can be direct or belt-driven from the compressor flywheel. Rugged construction and over-size bearings guarantee long life.



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pipeline news • *Cont'd.*

Because the Senate failed to act during the past session, more and more problems are piling up for the FPC and producers. The FPC doesn't expect to make much progress while under a mandate from the Supreme Court to exercise jurisdiction over the producers while at the same time one branch of Congress and a committee of the other branch have said it shall not have such jurisdiction. "Exploratory" hearings discussions of possible approaches, and regulatory short cuts will have to substitute for definite regulatory action until the final question of FPC jurisdiction is settled.

Even if the bill does pass next session, some FPC jurisdiction over producers is provided which will involve more litigation for producers. Among other things, control over contracts containing certain types of escalation clauses, and others where the figure is in excess of the "reasonable market price" will have to be defined.

ODM okays Panhandle's rapid tax-write-off

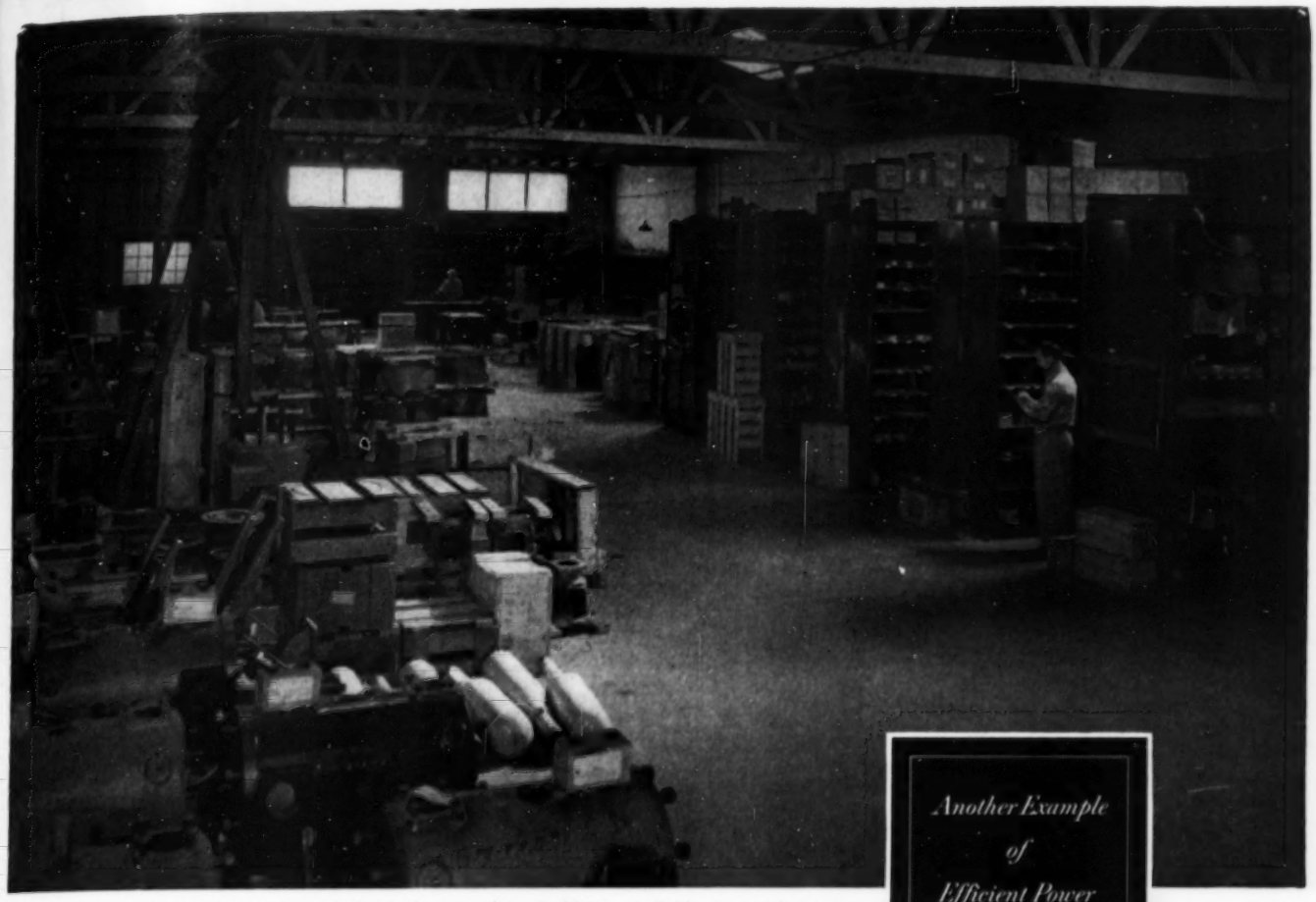
Panhandle Eastern Pipe Line Co., Kansas City, received the second largest fast tax write-off allowance granted by the government during the two-week period ended June 29. The Office of Defense Mobilization authorized Panhandle to amortize 25% of $24,655,700 worth of gas transmission facilities at the fast rate.

During the period, ODM issued 30 certificates of necessity authorizing rapid tax amortization for $103,998,653 worth of new or expanded industrial facilities, with petroleum refineries and pipeline companies receiving the bulk of the quick write-offs.

TET and Penn-Jersey get okay to move compressors

Texas Eastern Transmission Corp. and Texas Eastern Penn-Jersey Transmission Corp. have received FPC authorization of a joint application (Docket G-8931) to shift 10,000 hp presently installed or authorized for construction on the TET system to the Penn-Jersey system and to construct additional hp on the TET system and two small loop lines in the Philadelphia area. The cost of the project is estimated at $2,597,400 for Texas Eastern and $2,836,000 for Penn-Jersey.

The new facilities, which will increase the system capacity east of Oakford storage to approximately 843 MMcf/day, will give Texas Eastern greater flexibility in its Philadelphia-



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pipeline news • *Cont'd.*

New Jersey delivery area and will permit deliveries in that area of larger quantities of gas on peak days.

The project includes an arrangement to shift hp at TET's Phoenixville, Chambersburg, and Wind Ridge (Pa.) stations to the Penn-Jersey system; construction of 3300 additional reciprocating hp at TET's Linden, N. J., station; and construction of 11 miles of loops in the Philadelphia area. Penn-Jersey facilities include two 5000-hp gas turbine centrifugal stations at Perulack and Grantville, Pa.

Hugoton withdrawal rate probe dismissed

Kansas Corporation Commission has dismissed its probe into the comparative rate at which major companies are taking gas from the Kansas side of the Hugoton field (GAS, June, p. 158).

If it had been found that gas was being withdrawn faster on the Oklahoma side than on the Kansas side, Commission Chairman Robertson said it would be damaging to correlative rights of Kansas landowners and royalty owners and could mean actual drainage of gas from the Kansas side to Oklahoma wells.

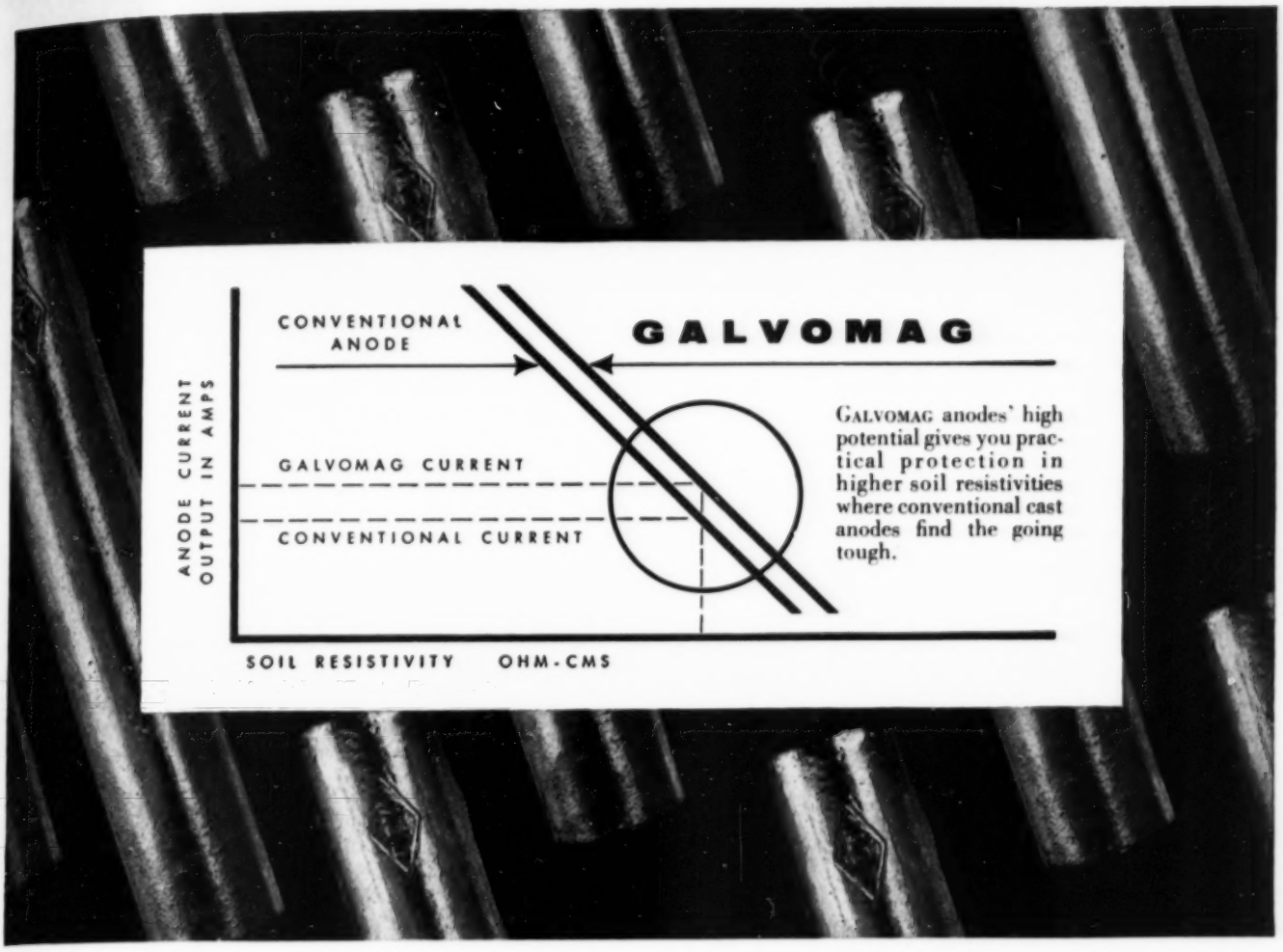
The order dismissing the probe revealed, however, that the commission "having examined and considered its files and records and being fully advised in the premises, finds: that the matter herein should be dismissed and the docket closed."

Lone Star would sell gas to Natural Gas Pipe Line

Hearing has been scheduled to commence Sept. 12 on an application by Lone Star Gas Co., Dallas, requesting authority to construct a 230-mile pipeline in Oklahoma and Texas to make available 100 MMcf of gas per day at Fritch, Texas, to Natural Gas Pipe Line Co. of America, Chicago (Docket G-8763).

Lone Star's proposed $18.7 million project, to consist of 22- and 26-in. pipe, would extend from a connection with the company's existing facilities in Cotton county, Okla., to a point near Fritch in Hutchinson county, Texas. In addition, the application asks authorization for the operation of certain existing facilities which Lone Star said it has been operating for the purpose of gathering gas but which now would be used for transportation of gas in interstate commerce.

Natural Gas Pipe Line has not entered into a contract with Lone Star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but instead is proposing to construct a pipeline from Jack and Wise counties, Texas, to Fritch in order to augment its system supply by an initial average daily volume of 78 million cubic feet. Natural's application for construction and operation of a total of about 350 miles of pipeline in Texas and Oklahoma at an estimated cost of $28,487,000 was consolidated for hearings with these applications by independent producers which are proposing to sell natural gas to the Chicago company. Lone Star is proposing to sell gas to Natural at a price of approximately 20.5 cents per thousand cubic feet, as compared with a claimed cost by Natural of 35.6 cents in its application.

FPC approves plans of Montana-Dakota Utilities

Montana-Dakota Utilities Co., Minneapolis, has been granted a certificate by the FPC authorizing it to construct a total of approximately 44 miles of pipeline and 1090 hp in compressor capacity on its natural gas transmission system in South Dakota and Wyoming (Dockets G-8767 and 8843).

Approximately 30½ miles of the new line and 540 hp in compressor capacity will be used to replace existing facilities in Harding and Butte counties, S. D., and Fallon county, Mont. The other new facilities include approximately 9 miles of line extending to the Ellsworth Air Force base near Rapid City, S. D., and about 4½ miles of line to Signal Oil and Gas Co.'s proposed desulphurizing plant in Washakie county, Wyo.

The FPC's order also issued a certificate to Signal, an independent gas producer, authorizing that company to sell to Montana-Dakota natural gas processed at the proposed plant.

Montana-Dakota's construction plans also include a 550-hp unit at a compressor station in Hot Springs county, Wyo., and the company plans to lease and operate an additional 889-hp compressor unit to be installed by Montana-Wyoming Gas Pipe Line Co. in its Worland compressor station in Washakie county, Wyo.

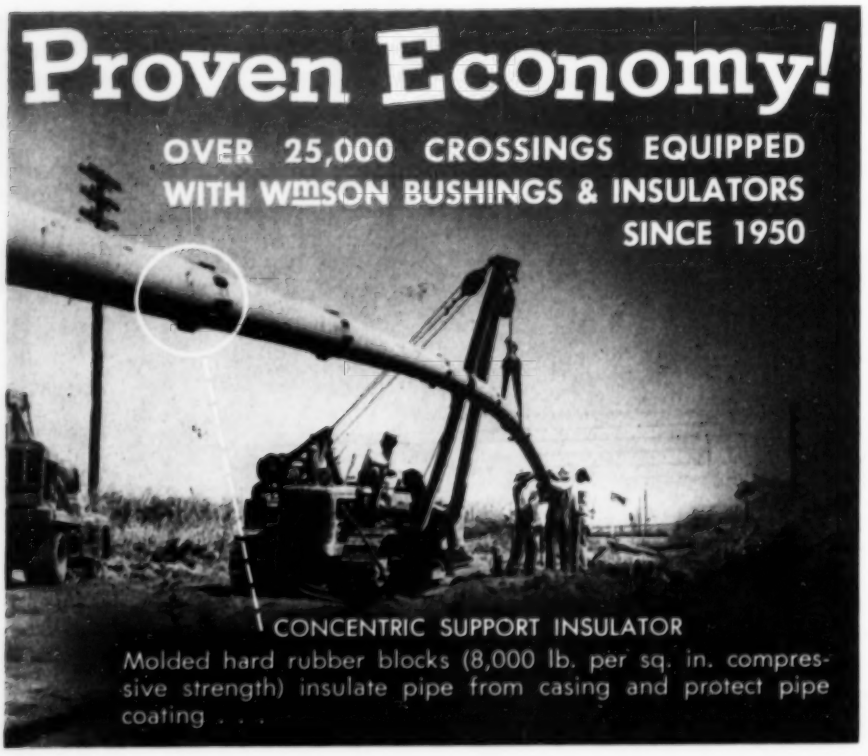
Construction to boost Wilcox to 200 MMcf

Wilcox Trend Gathering System Inc., Shreveport, subsidiary of Texas Eastern Transmission Corp., has received FPC approval for $2.9 million additions to its system which will increase Wilcox's capacity to approximately 200 MMcf of gas per day.

It is expected that the entire project will be completed by the end of this year. The proposed facilities include a new 2000-hp compressor station to be located in Goliad County near Charco, Texas; additional compression totaling 2200 hp to be added to the company's existing station near Thomaston, Texas; 16 miles of 16-in. line looping a portion of the company's mainline, some additional small diameter lines, and one 75-hp field compressor station. The company will also purchase two existing lateral lines which connect wells to the company's mainline.

TET offers capital stock shares for production firm

At a recent meeting, directors of Texas Eastern Transmission Corp. authorized an offering of shares of its capital stock in exchange for shares of the capital stock of Texas Eastern Production Corp. in the ratio of one share of TET stock for each 2.6 shares of TEP stock. George T. Naff, president of Texas Eastern Transmission, stated that his company's action is contingent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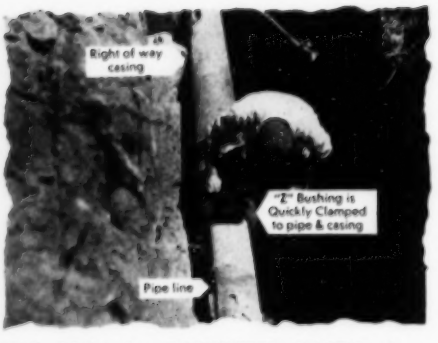

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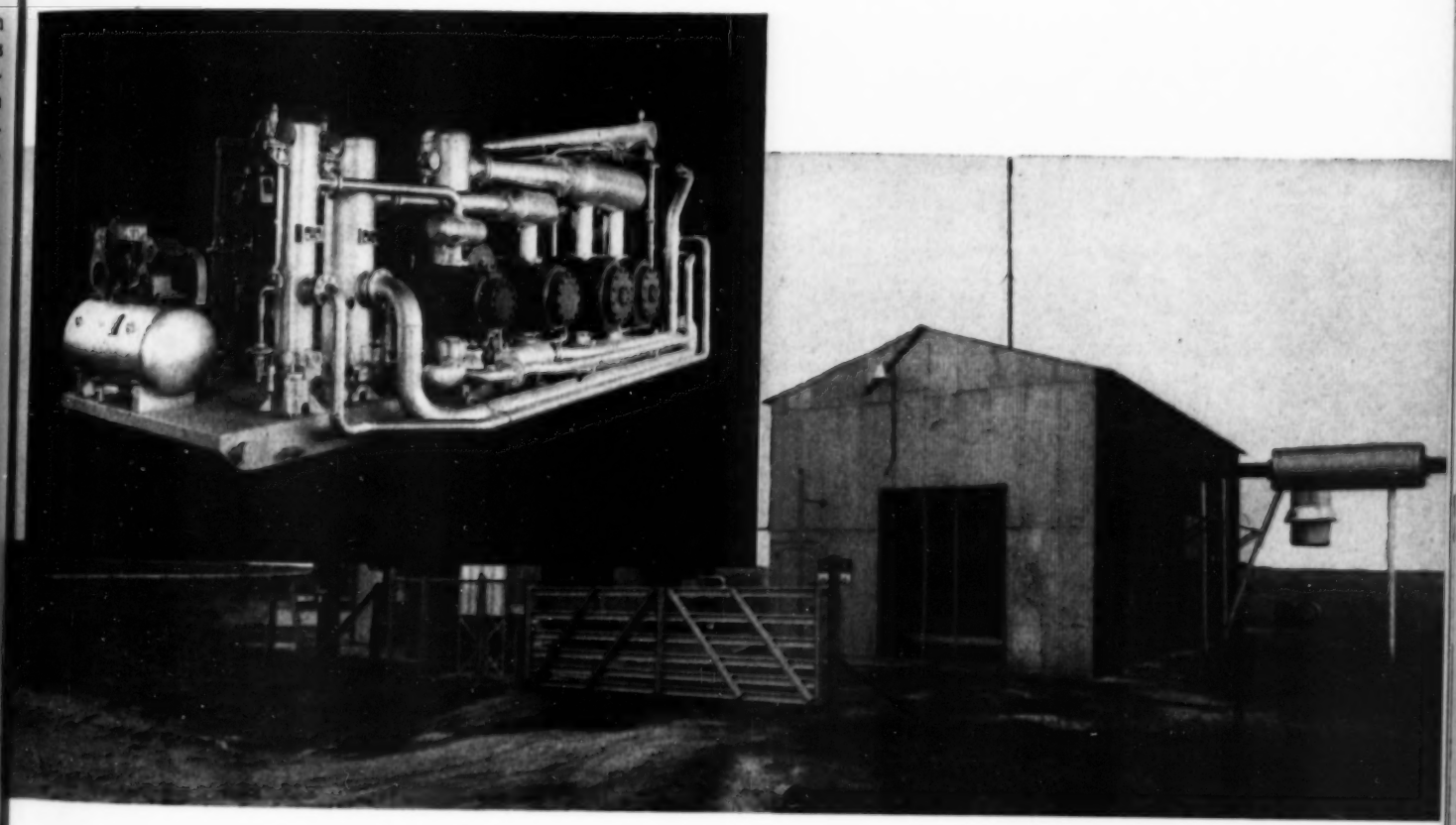

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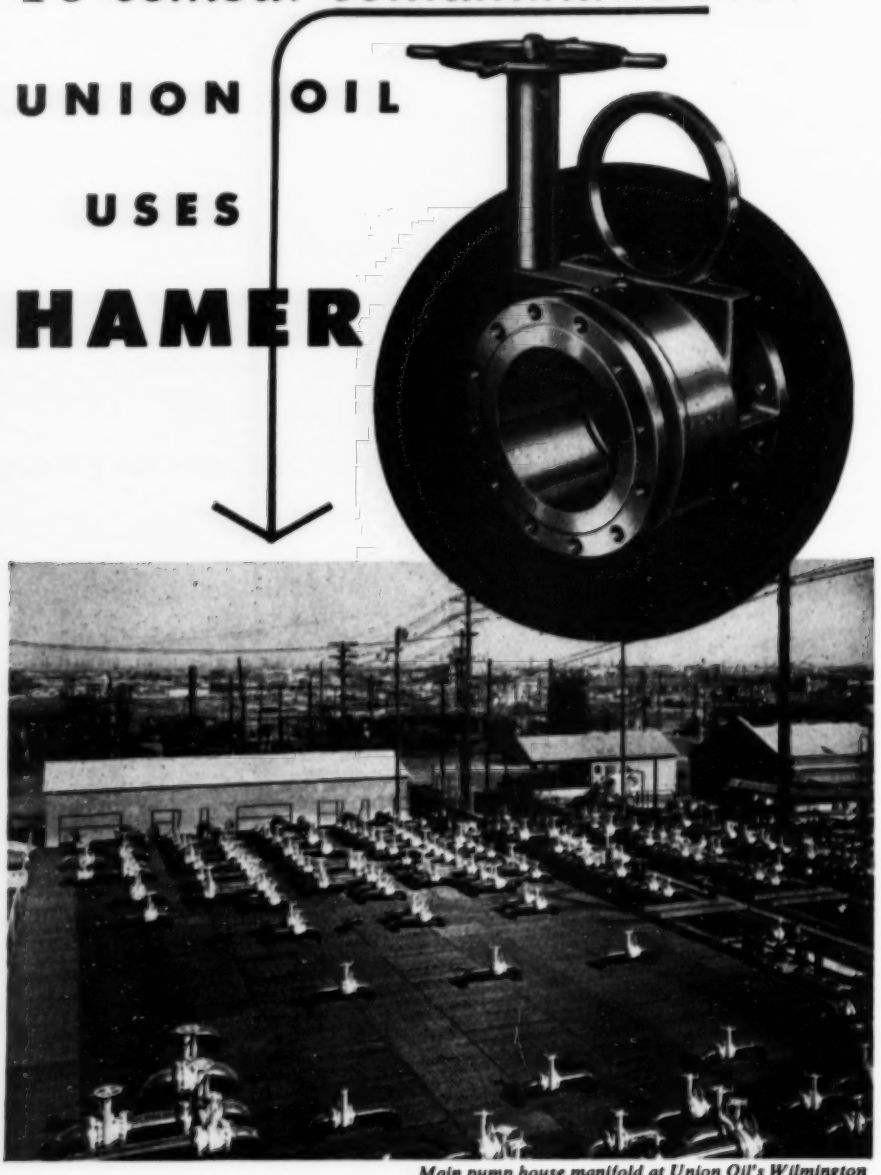

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upon the tender of at least 263,402 shares in response to the offer.

According to Mr. Naff, a registration statement relating to the offer was filed with the SEC on July 25.

"The purpose of the offer is to acquire shares of Texas Eastern Production Corp. stock in addition to the 68.64% of the shares already owned by Transmission so that thereafter Transmission will own 80% or more of the capital stock of Production, 80% being the minimum percentage of Production capital stock required to permit the inclusion of that company in Transmission's consolidated federal income tax returns," Mr. Naff stated.

American Louisiana finance plans approved by SEC

The SEC has authorized the financing plan of American Natural Gas Co. and American Louisiana Pipe Line Co. by which American Natural would sell 736,856 shares of common stock to shareholders through rights on the basis of one new share for each five shares held, and would use $20 million of the proceeds to purchase common stock of American Louisiana and the balance would be used to purchase the stock of other subsidiaries.

The SEC also authorized American Louisiana to sell $87,750,000 of first mortgage bonds to Metropolitan Life Insurance Co. and $9,750,000 to Mutual Life Insurance Co. of New York.

Southern Natural would build new facilities

Southern Natural Gas Co., Birmingham, has applied for authorization to construct an estimated $2,157,00 of natural gas facilities consisting of approximately 39 miles of loop lines with addition of 4950 hp in two existing compressor stations; 5.5 miles of replacement line near Atlanta, Ga.; and 5.3 miles of pipeline to connect existing facilities with a new gas supply from the Patterson Field, St. Mary parish, La.

The construction pends approval by the FPC of an application by United Gas Pipe Line Co., Shreveport, for authority to sell 50 MMcf of gas per day to Southern.

Also consolidated with the Southern-United hearing were applications by the following requesting an FPC order directing Southern to establish physical connection of its facilities with proposed facilities of their own and to sell gas to them: Marshall, Lamar, and

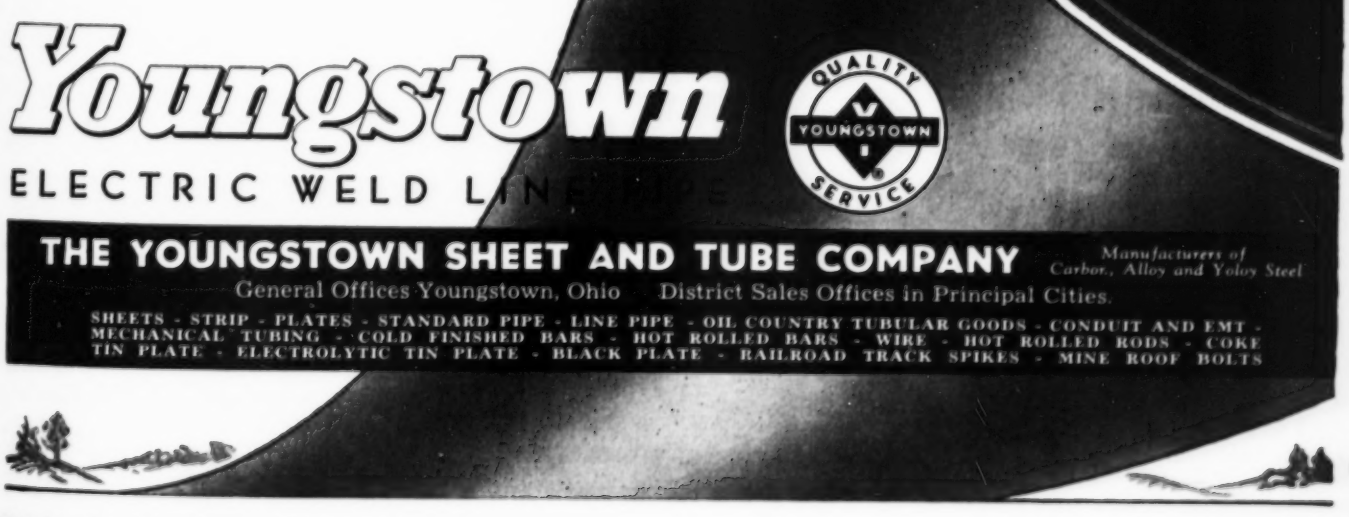
giving you the EDGE

ON YOUNGSTOWN ELECTRIC WELD LINE PIPE

You "Get the Edge" when you buy Youngstown high strength line pipe. This is provided thru careful control of end preparation to give you accurately beveled ends that will line up quickly and easily and make a satisfactory joint.

Chemical composition of the pipe is controlled to provide maximum weldability and ductility consistant with high strength requirements. This gives you excellent bending characteristics.

Youngstown Electric Weld Line Pipe in sizes 6" to 22" inclusive are produced in long lengths, with uniform walls.



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Manufacturers of Carbon, Alloy and Yoloy Steel

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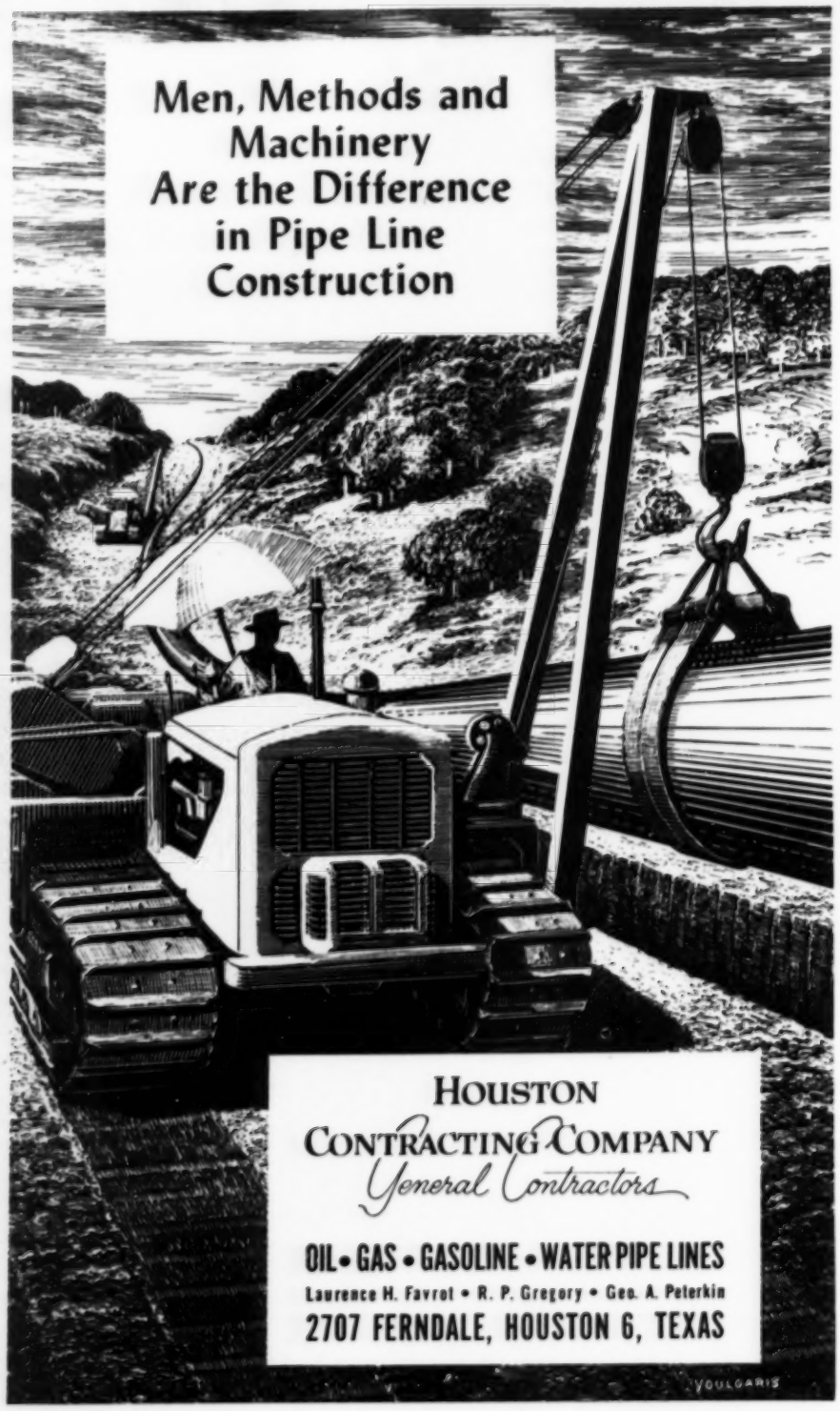
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Greene-Hale counties gas districts; the towns of Double Springs, Phil Campbell, Vincent, Eclectic, and Mulga, all in Alabama; the Mid-Georgia Natural Gas Co.; and the town of Tchula, Miss. Total estimated cost of their proposed pipeline facilities is $4,565,000.

Kansas and Oklahoma job approved for Cities Service

Cities Service Gas Co., Oklahoma City, has been authorized to construct approximately 238 miles of pipeline and a new 2700-hp compressor station on its natural gas transmission system in Kansas and Oklahoma to increase the daily capacity of the company's system by approximately 50 MMcf in 1955 and 100 MMcf thereafter (Docket G-8780).

El Paso-Pacific plans opposed at early hearings

Proposals of El Paso Natural Gas Co. and Pacific Northwest Pipeline Corp. to import Canadian gas for use in the Pacific Northwest and California got off to a bad start, when several objections, mostly about point of delivery, were raised at preliminary hearings.

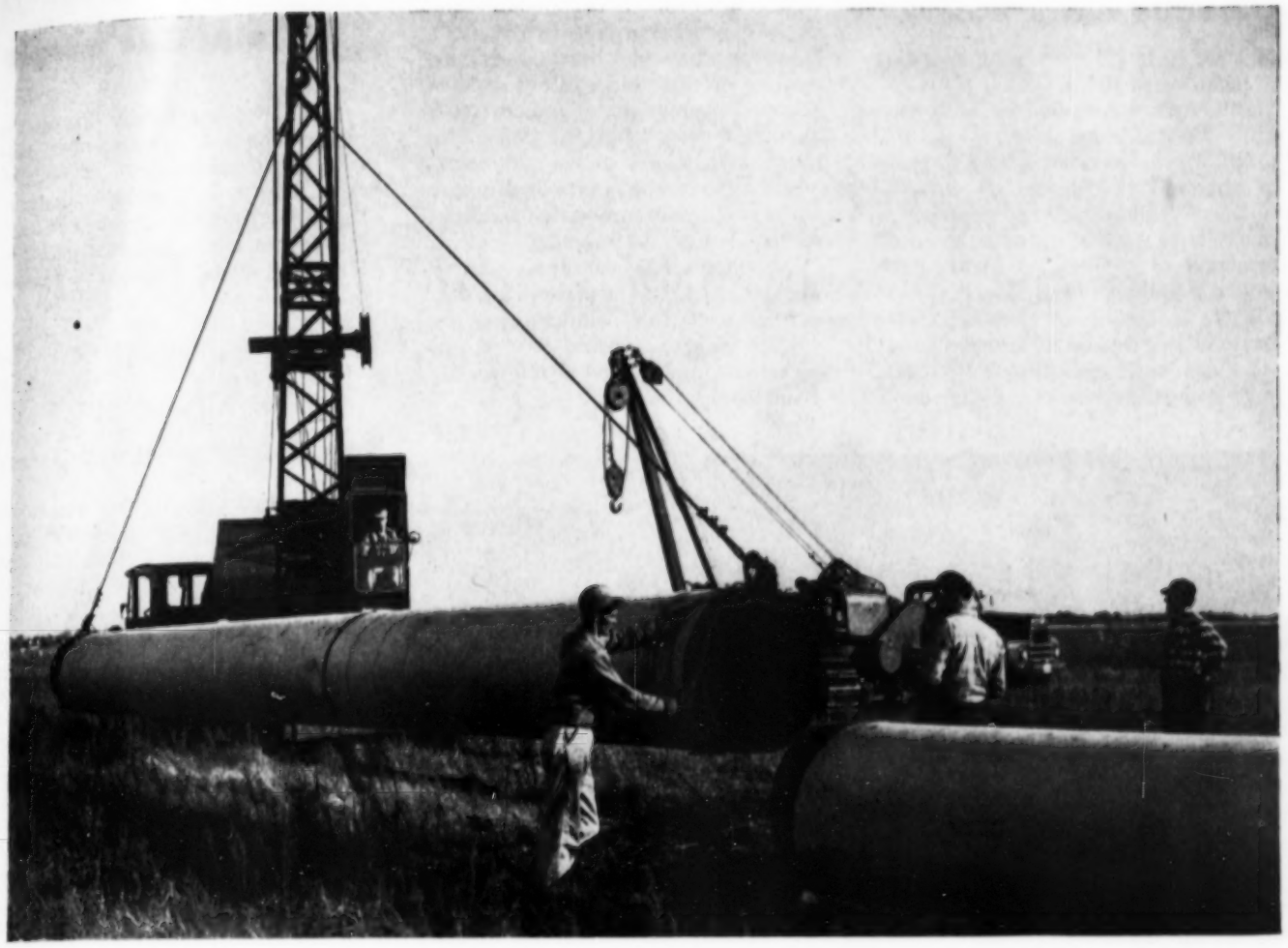
Pacific Gas & Electric Co., San Francisco, says it won't take any gas from El Paso except at Topock, while El Paso had originally planned to deliver it near Reno, Nev. Now El Paso proposes to continue the line from Reno to the San Francisco Bay area, delivering to PG&E's doorstep the 250 MMcf from Pacific Northwest.

Another objection is raised by Colorado Interstate Gas Co., which claims that if FPC upholds PG&E's objection to take gas at any point other than Topock, the volume of gas to be transported over Pacific Northwest's new line from San Juan basin to Washington would be reduced, increasing the price of gas to be purchased by CIG at Rock Springs.

Additional opposition is raised by the coal interests and the Oil Producers Agency of California, who say that the importation of natural gas from Canada would impair the market for crude oil.

Northern's system increase to 1.1 billion MMcf okay

Northern Natural Gas Co., Omaha, has FPC authorization to construct new facilities in Texas and Iowa to increase its system capacity by 30,513,000 cu ft of gas per day, to a new total of 1,130,-



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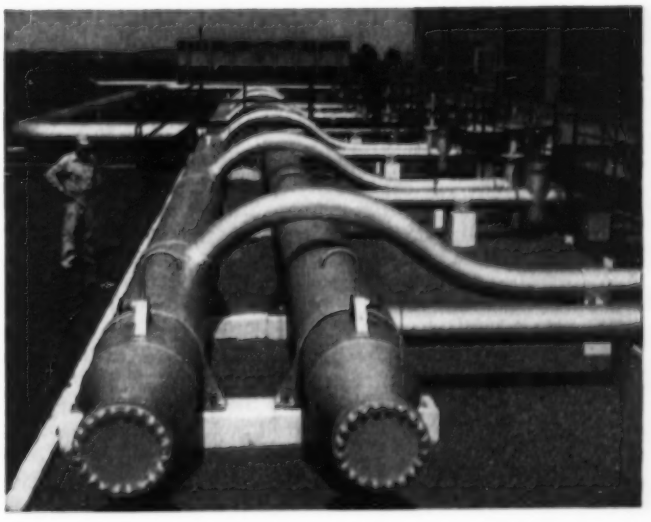
COLD-EXPANDED LINE PIPE. With the recent installation of facilities for hydraulic expansion at our Steelton, Pa., plant, we are now able to offer the oil and gas industries cold-expanded, electric-fusion-welded line pipe from 18 in. to 36 in. OD. Available in wall thicknesses to ⅝ in. and in 40-ft lengths. We are equipped to grit-blast, prime, coal-tar-enamel and wrap the pipe to your specifications.

HIGH-STRENGTH PIPE. For use at compressor stations and wherever high pressures, pulsation and vibration are encountered, we recommend pipe fabricated from Mayari R, our high-strength, low-alloy steel (yield point—50,000 psi min; tensile strength—70,000 psi min). This pipe has exceptional endurance strength (about 50,000 psi) as well as good ductility and impact qualities. Welds readily using normal procedures.

More information about Bethlehem Gas Pipe is yours for the asking. We suggest that you contact the Bethlehem sales office nearest you.



BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

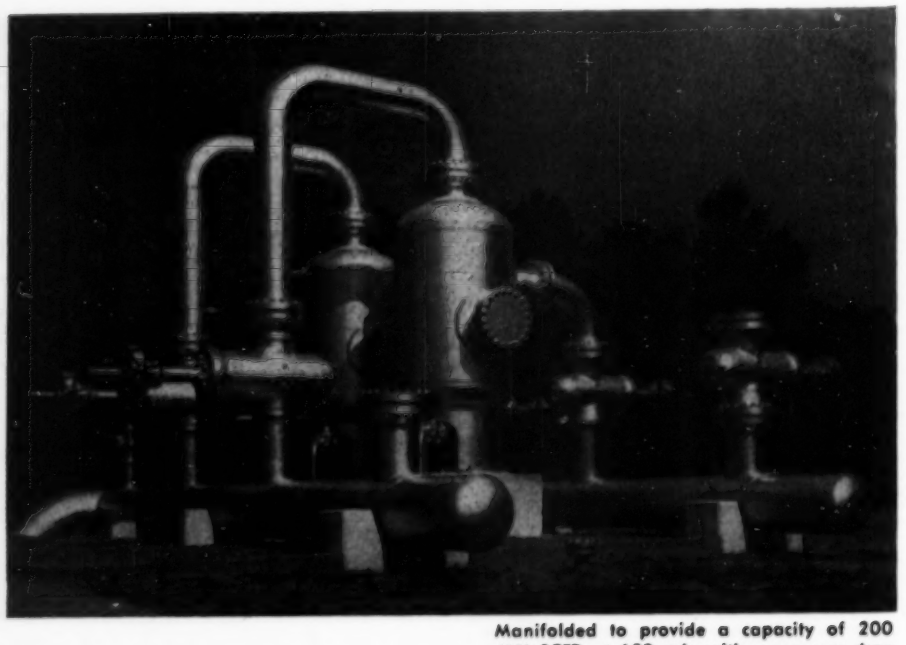
pipeline news • *Cont'd.*

569,000 cu ft (Docket G-2063, et al).

Included in the $760,000 plans are a 2000-hp compressor unit at Northern's Sunray, Texas, station and 6½ miles of 6-in. pipe paralleling sections of existing line in Iowa.

Northern originally had proposed a much larger project, including the construction of facilities to enable it to import natural gas from Canada to supply its customers in the Midwest. Hearings on the proposal to bring in Canadian gas were consolidated for hearings—which commenced in January—with several related proposals involving an expansion of Northern's system. However, when these hearings resumed in June of this year, the FPC said, it became apparent that Northern could not obtain natural gas from Canada for the coming winter season and, consequently, the company proposed to construct facilities to meet only part of the demand for gas on its system.

Northern plans to supply the remaining demands for gas on its system during the 1956-57 winter season, and will file new and amendatory or supplemental applications covering that proposed service.



Manifolded to provide a capacity of 200 MM SCFD at 650 psig with a pressure drop of 1.5", these Aerotec units remove both dust and liquids from the gas.

AEROTEC GAS SCRUBBERS

designed to remove solids or liquids

On this 845 mile, 30" feeder line from Louisiana to West Virginia, five compressor stations present wide variations in contamination of gas being transported.

At some stations, the scrubbing problem presented is one of dry dust removal. All others, fluid carryover requires the removal of dust and liquid. Aerotec Scrubbers for these compressor stations were designed to handle the conditions encountered at each station. Resulting gas delivered to the 8000 horsepower compressors is dry and free from abrasive dusts.

Aerotec Gas Scrubbers are noted for their ability to deliver gas, free of fluid carryover. No liquids used in the scrubbing process makes this possible. Temporary overloads of up to 100% are easily handled without efficiency loss.

Contact our project engineers today. Ask for Thermix Data Sheets.

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THE AEROTEC CORPORATION
Aircraft Division Greenwich, Conn.

GAS pipeline people

L. O. F. Glass Fibers Co. has appointed KEN C. SETTLEMYER sales manager of the midwest region, Chicago; ROBERT E. SIMPSON, sales manager of the southwest region with headquarters in Houston; and ROBERT N HEYMAN, district manager of the Dallas area.

In addition, THOMAS L. CARVER has been appointed sales manager for the eastern region, headquartering in New York, and JOHN B. BANKS is sales manager of the central region, Detroit.

Tube Turns, Louisville, has appointed W. C. ROBINSON as assistant sales manager and FRANK BRIGGS has joined the staff of the company's sales development department.

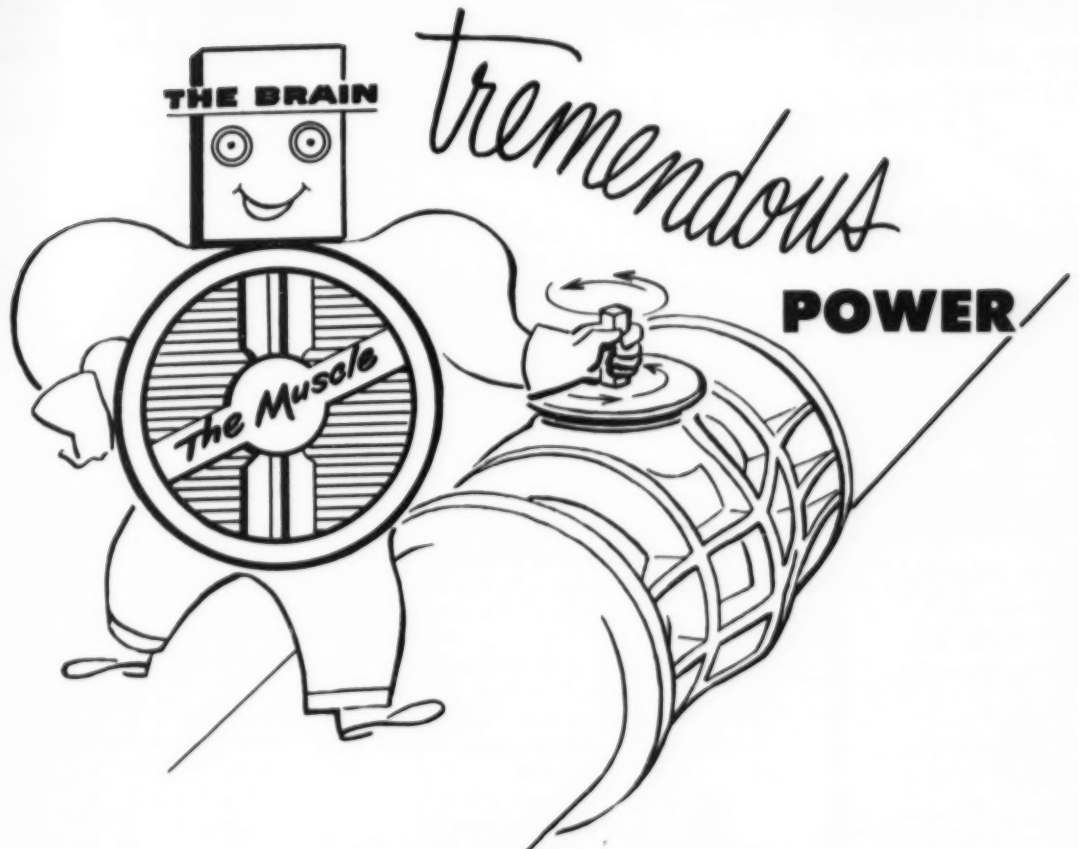
Several advances have been announced by Texas Gas Transmission Corp., Owensboro, Ky. E. F. HINDMAN is manager of the newly created Louisiana division in Lake Charles; WILLIAM B. THRELKELD has succeeded JOHN W. POLKINGHORN, retiring, as director of the land and lease department, and has been named assistant secretary; RALPH W. THACKER has also been named assistant secretary; LOUIS S. ARRINGTON is supervisor of geologists; ALFRED E. LITTLE is supervisor of proration, and ROBERT D. NORTHCUTT is supervisor of reservoir engineering.

ERNEST NUBER has been promoted to general field sales manager for the Bristol Co., Waterbury, Conn.

Several promotions have been announced by Cooper-Bessemer Corp. Mt. Vernon, Ohio. JAMES W. REED, vice president, is Pacific Coast manager, in charge of offices in Los Angeles, San Francisco, and Seattle. JOHN ROGERS, who held the position for the past 15 years, is now special representative and consultant. C. M. REAGLE is now district manager of the New York domestic territory.

J. N. CARPENTER is superintendent of Lone Star Gas Co.'s pipeline department. He succeeds LUTHER TOLBERT, who has retired.

CHARLES W. LEE, who was previously vice president and general manager of Consolidated Western Steel division of United States Steel, has become president of that division, succeeding ALDEN G. ROACH. Mr. Roach is president of Columbia-Geneva Steel division. The National Tube division



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- TREMENDOUS POWER DIRECTLY ON VALVE STEM—NO LEVERS—NO GEARS—NO CLUTCHES
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pipeline people • *Cont'd.*

of U. S. Steel has appointed KENNETH LIEBER to the post of assistant vice president-sales. He has been vice president-engineer for Consolidated since Jan. 1.

HENRY A. JACKSON JR. has been appointed assistant secretary of New York State Natural Gas Corp., Pittsburgh.

S. N. CAMPBELL has been assigned to the Houston office of Cooper-Bessemer Corp., where he will handle the engineering and sales of centrifugal, motor, and engine driven compressors.

ALLEN B. HIATT has been named assistant to the president of Pacific Northwest Pipeline Corp. He was formerly with Phillips Petroleum Co.

FRED H. MCINTIRE has joined American Louisiana Pipe Line Co. as assistant to the president. In addition to his other duties, Mr. McIntire will serve as director of personnel.

PHILIP R. COERPER has been appointed sales engineer in the Power Chief Engine department of Nordberg Manufacturing Co., Milwaukee.

GAS progress reports

NEW CONSTRUCTION PLANNED

LONE STAR GAS CO., Dallas. Docket G-8763 for 230-mile 22- and 26-in. line extending from existing facilities in Cotton county, Okla. to Fritch in Hutchinson county, Texas, to make available 100 MMcf of gas/day at Fritch to Natural Gas Pipe Line Co. of America.

SOUTHERN NATURAL GAS CO., Birmingham. Docket G-8742 for 39 miles of loop line and 4950 hp addition at two existing compressor stations; replace 5.5 miles of line near Atlanta; and construct 5.3 miles to connect existing facilities with new gas supply from Patterson field in St. Mary parish, La.

CURRENT CONSTRUCTION

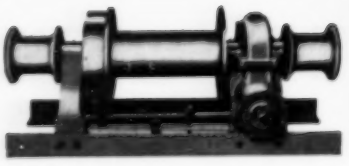
ARKANSAS LOUISIANA GAS CO., Shreveport. Docket G-2307 for 134 miles of 6⅝- to 24-in. line in 11 sections, and 10,500-hp compressor station on its system in Arkansas, Louisiana, and Texas. Compressor station and 71 miles of line completed.

ATLANTIC SEABOARD CORP., Charleston, W. Va. Docket G-6500 for 84-mile, 26-in. line paralleling Cobb (W. Va.)-Baltimore (Md.) line in West Virginia, Virginia, and Maryland, and 2000 additional hp at Cleveland station in Upshur county, W. Va. Williams-Austin Co. working on 31 miles in Brafton, Upshur and Randolph counties, W. Va.

CITIES SERVICE GAS CO., Oklahoma City. Docket G-8571 and 8572 to install 39 miles of replacement line in Newton, Lawrence, Lafayette, and Johnson counties, Mo., and Johnson county, Kan.

PIPELINE CONTRACTORS SPECIFY . . .

TULSA* WINCH



This contractor's truck mounts a Model 23 Tulsa Winch. The earth auger is powered forward with a Model 19 Tulsa Winch.

Contractors everywhere choose Tulsa Winch to lighten their equipment-moving jobs. Tulsa Winches are available in 28 models, in capacities from 6,500 to 80,000 lbs., for every model and make of truck or crawler tractor.

Tulsa* Winch
TULSA, OKLAHOMA DIVISION OF VICKERS Inc.

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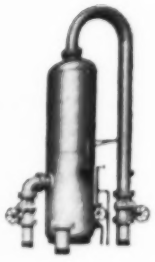
BLAW-KNOX gas cleaners thoroughly scrub gas with oil no screens to clog no cyclones to fail



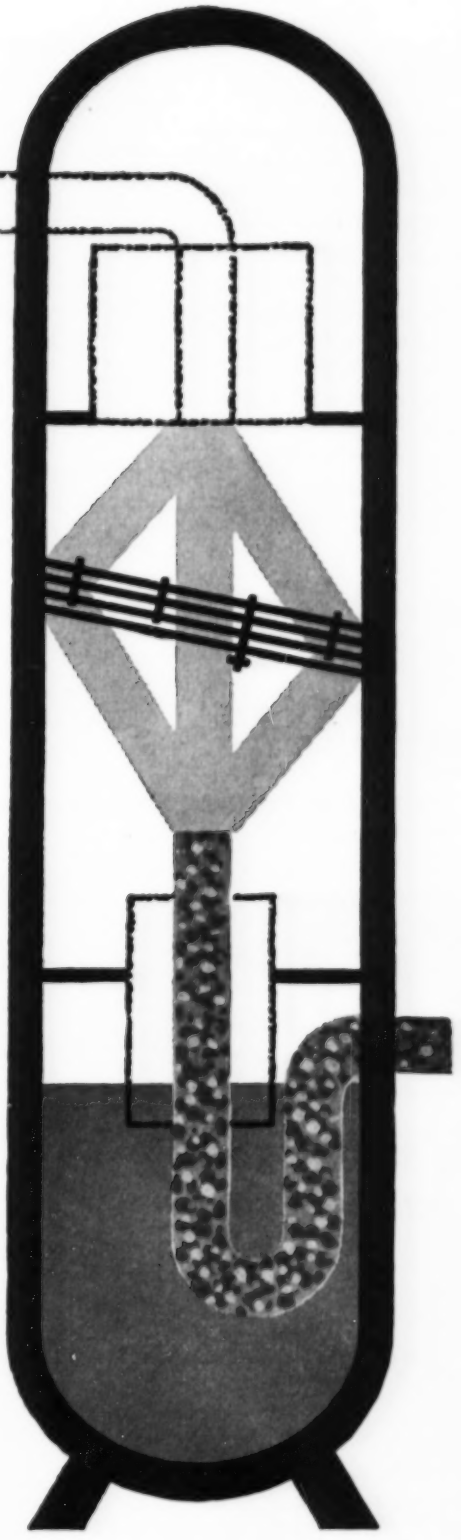
Blaw-Knox Gas Cleaners are engineered and built to remove dusts of all sizes under the most severe operating conditions with an absolute minimum of attention. There are no screens to clog or cyclones to erode and fail, reducing operating efficiency.

Immediately upon entering a Blaw-Knox Gas Cleaner, dust is violently, intimately washed with oil. The major portion of the heavier dust particles are actually scrubbed from the gas during this initial stage.

Remaining tiny wet dust particles are caught and agglomerated by a multiple baffle, primary separator. This separator is kept clean and operating at peak efficiency by continual recirculation of oil which washes particles down into a dust reservoir.

Finally, the gas flows through another expansion separation stage and into a multiple vane extractor which scrubs it clean of oil mist.

Traveling at high velocities, microscopic particles of pipeline dust sandblast regulators, compressor parts and metering devices, resulting in replacement costs, loss of revenue and customer ill will. Clean gas costs you less. So, when you buy, specify a Blaw-Knox Gas Cleaner and be sure that you're removing dusts of all sizes.



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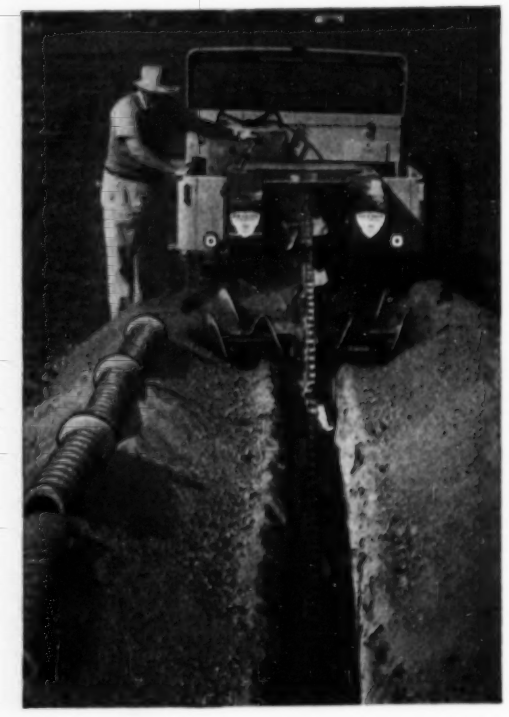
This 'Jeep'-propelled trencher digs trenches up to 6 feet deep and 14 inches wide. Mounted on the 4-wheel drive 'Jeep', it gets to the job in a hurry, and speeds up the laying of pipe, cable or drain tile. Traveling speedily to the job, the unit is ready for trenching in a matter of minutes. Greater mobility makes the 'Jeep' trencher profitable for short trenches. See your nearest Willys dealer or write for information.



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covered **53** miles

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Allan Edwards, Inc.

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COLORADO INTERSTATE GAS CO., Colorado Springs. Docket G-2121 - (1955 program) 385 miles of 22-in. line from Denver to connection with proposed Pacific Northwest Pipeline Corp. line at Green River, Wyo.; with 4400-hp compressor station near Green River. Houston Contracting Co. began construction June 15; 40 miles complete 8/1/55. Balance, 11/1/55.

EAST OHIO GAS CO., Cleveland. A 113-mile, 30-in. pipeline to serve Cleveland area from point just south of Toledo. Construction started April 15. Completion date: Oct. 1.

MICHIGAN GAS STORAGE CO., Jackson. Docket G-6501 for 36-mile 16-in. line and 3300 hp addition at Freedom compressor station in Michigan. Line would extend from Mt. Pleasant Junction to Milwaukee Junction. Work on compressor started May 16. Bechtel Corp. to start July 1 on line.

MONTANA - DAKOTA UTILITIES CO., Minneapolis. Docket G-8767 and 8843 for 30½ miles of new line and 540 hp in compressor capacity in Harding and Butte counties, S. D., and Fallon county, Mont.; 9 miles of line near Rapid City, S. D.; and 550 hp addition to station in Hot Springs county, Wyo. September completion.

NEW YORK STATE NATURAL GAS CORP., Pittsburgh. Docket G-8568 for 21 miles of 20-in. line paralleling section of line in Wyoming and Livingston counties, N. Y. to complete looping of line from Potter county, Pa. to near Caledonia N. Y. Potter-DeWitt Corp. now at work.

OHIO FUEL GAS CO., Columbus. Docket G-8752 for 19 miles of line and a new metering station in north Central Ohio. Ohio Pipe Line Construction Co. 25% finished with job.

PACIFIC GAS & ELECTRIC CO., San Francisco. An 18-mile, 12-in. line in Colusa and Glenn counties to bring gas into Sacramento valley from two new fields. September completion.

PACIFIC NORTHWEST PIPELINE CORP., Houston. Docket G-1429 for 1466 miles mainline; 443 miles of spur and lateral lines; and 14 mainline compressor stations totaling 81,120 hp and 2 booster stations totaling 3300 hp, to extend from Ignacio, Colo., in the San Juan basin, to Bellingham, Wash. (Seattle area). Fish Northwest Constructors Inc., builders of the line, have let contracts to River Construction Corp., R. H. Fulton & Co., Associated Pipeline Contractors, A. J. Curtis Construction Co., B. & M. Construction Co., Midwestern Constructors Inc., H. B. Zachry Co. and Fulghum Construction Co. for first 655 miles.

PANHANDLE EASTERN PIPE LINE CO., Kansas City, Mo. Docket G-2433 for construction of 294.5 miles of mainline loops, 106.3 miles of lateral loops, and 4750 additional hp. The 294.5 miles located in Kansas, Missouri, Illinois, Indiana, and Ohio were constructed in 1954 and are being operated under a temporary FPC permit. Remainder of work is being held in abeyance until approved by FPC.

SOUTH GEORGIA NATURAL GAS CO., Birmingham, Ala. Docket G-1915 for 368-mile, 12¾-in. line beginning at connection with Southern Natural line in Lee county, Ala., extending southeast to serve new communities in Georgia and Florida. Expected completion date: September 1955.

SOUTHEAST ALABAMA GAS DIST., Birmingham. A "U" shaped system of about 330 miles to serve 24 communities in southeastern Alabama from connections with Southern Natural. About 95% completed. Scheduled for completion in September.

SOUTHERN COUNTIES GAS CO., Los Angeles. To build 31.5 miles of 30-in. line between Cactus City and Desert Center in Riverside county, Calif., to complete paralleling of the California-Texas pipeline system.

TENNESSEE GAS TRANSMISSION CO., Houston. Dockets G-2310, G-2330 and G-2331. Construction is well advanced in Pennsylvania, New Jersey, and New York on a 250-mile, 24-in. line from Hebron (Pa.) storage field to Greenwich, Conn., and an 18-mile 24-in. Hebron to Harrison storage field plus 36 miles of 26-in. loop in Ohio have been completed. Development of two more storage fields—Colden near Buffalo; Har-

rison, in Potter county, Pa. Construction is underway at Isola, Miss., and at Morehead, Ky., on new compressor stations. This fall company will construct 370-mile, 30-in. line from Agua Dulce, Texas, to Kinder, La., along Texas and Louisiana Gulf Coast line (Docket G-8215).

TEXAS EASTERN TRANSMISSION CORP., Shreveport, and **NEW YORK STATE NATURAL GAS CORP.,** Pittsburgh. Docket G-2784 to construct field pipelines to connect up additional wells in Murrysville pool; acquire 2000-hp field gathering compressor station; and install 1980-hp station. New York State will operate facilities.

TEXAS EASTERN TRANSMISSION CORP., Shreveport. Docket G-2503 for 477 miles of line, 91,400 hp in new compressor stations, and 36,020 hp additions at existing stations—all to be located in Texas, Louisiana, Mississippi, Tennessee, Kentucky, Ohio, Pennsylvania, and Alabama. Project would include a 377-mile line from Beaumont, Texas, to Kosciusko, Miss. The following contracts have been let: Houston Contracting Co., 59 miles; Tulsa Williams Co., 118 miles; H. C. Price Co., 134 miles; H. B. Zachry Co., 64 miles. Brown & Root Inc. will construct the compressor stations and furnish field supervision. Pipeline construction under way; compressor work starting.

TEXAS GAS TRANSMISSION CORP., Owensboro, Ky. Docket G-6854 to lay 77.14 miles of partial loops in 7 sections between Covington, Tenn. to Jeffersontown, Ky.; 74 miles, 12-in., 35 miles 10-in., and 5 miles, 8-in. between Hardinsburg, Ky. compressor station and Columbus and Bedford, Ind.; to construct 26-in. crossings of Tennessee and Cumberland rivers in Kentucky and dual 12-in. crossings of Ohio river near Hardinsburg, Ky.; to build 4500-hp station at Columbia, La., and to add 4000 hp at Greenville and Clarksburg, Miss.; 2000 hp at Lake Cormorant, Miss., and 1500 hp at Covington, Tenn. H. C. Price Co. to lay 26-, 12-, 10-, and 8-in. lines (except river crossings); Houston Contracting Co. to lay 20-in.; Pentzein Inc. to lay Cumberland, Tennessee and Ohio river crossings. Completion set for Oct. 31, 1955.

TRANSCONTINENTAL GAS PIPE LINE CORP., Houston. Docket G-4185 for 360 miles of 36- and 30-in. line paralleling sections of system in nine states. Would include two river crossings; one 3000-hp and one 7500-hp station and miscellaneous additions to present stations. Contracts let to O. R. Burden Construction Corp., Associated Pipe Line Contractors Inc., Midwestern Constructors Inc., Houston Contracting Co., Western Constructors, Panama-Williams Co.

TRANSCONTINENTAL GAS PIPE LINE CORP., Houston. Docket G-2367 for 173 miles of 30- and 36-in. loops to parallel sections of existing system in Louisiana, Mississippi, Alabama, Georgia, North and South Carolina, Virginia, and Maryland, plus 46 miles of 12-in. and 16-in. loops and 12-mile, 24-in. extension of mainline in New Jersey. Contracts let to O. R. Burden Construction Corp., Midwestern Constructors Inc., Panama-Williams Co., Williams Brothers Co., and Associated Pipe Line Contractors Inc.

APPROVED

CITIES SERVICE GAS CO., Oklahoma City. Docket G-8780 for 4- to 20-in. 93-mile line between Blackwell, Okla. and Independence, Kan.; 145-mile gathering system in Barber county, Kan. and Woods county, Okla.; and 2700-hp compressor station near Alva, Okla.

NORTHERN NATURAL GAS CO., Omaha. Docket G-2063 et al for 6½-mile 6-in. line paralleling existing line in Iowa and a 2000-hp compressor unit at Sunray, Texas station.

TRANSCONTINENTAL GAS PIPE LINE CORP., Houston. Docket G-9035 for approximately 27 miles of loops in Louisiana, Georgia, North Carolina, Virginia, and Maryland to transport 10 MMcf/day additional gas.

WILCOX TREND GATHERING SYSTEM, Shreveport. To build 16-mile 16-in. loop line near Provident City, Texas; 2000-hp compressor station in Goliad county; add 2200 hp to existing station at Thomaston; and one 75-hp field compressor.

4-wheel drive does another job better!

BACKFILLING

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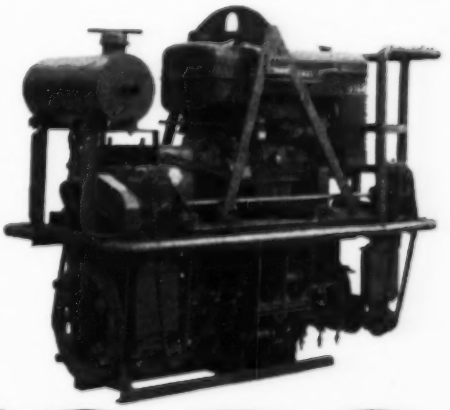

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